Electrical Contracting

AUGUST·1946

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE

In This Issue ... wiring for quick change and ready maintenance ... lighting a modern store ... combined supports and raceways ... handrail bridge lighting ... reconnection motors ... plus practical shop and job methods

IT'S BACK ON THE MARKET

THE *Famous* G-E general-purpose AUTOMATIC TIME-SWITCH

FEATURES OF THE T-44

Long, accurate service with minimum maintenance is assured by the use of the Telechron motor.

The simple construction—the small number of parts—reduce service calls that eat into profits.

A sturdy, weatherproof case permits either indoor or outdoor installations and eliminates damage in normal handling.

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For more information, check your regular supply house or write to Apparatus Department, General Electric Company, Schenectady 5, N. Y.

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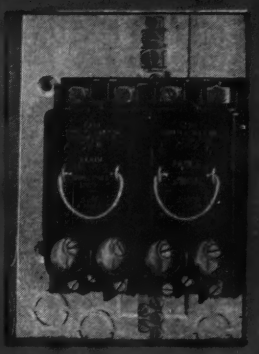
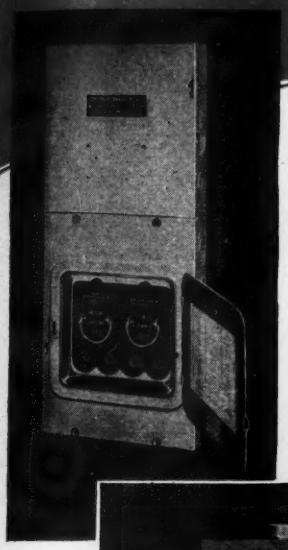
- **Protective lighting of outdoor areas**
- **Show- and store-window lighting**
- **Electric signs, billboards, and spectaculars**
- **Street lighting**
- **Airport lighting**
- **Traffic control, alarm, and signal systems**
- **Poultry house lighting**
- **Domestic furnaces and water heaters**

GENERAL ELECTRIC

What switch," say you? These "PULL-OUTS", say contractors!





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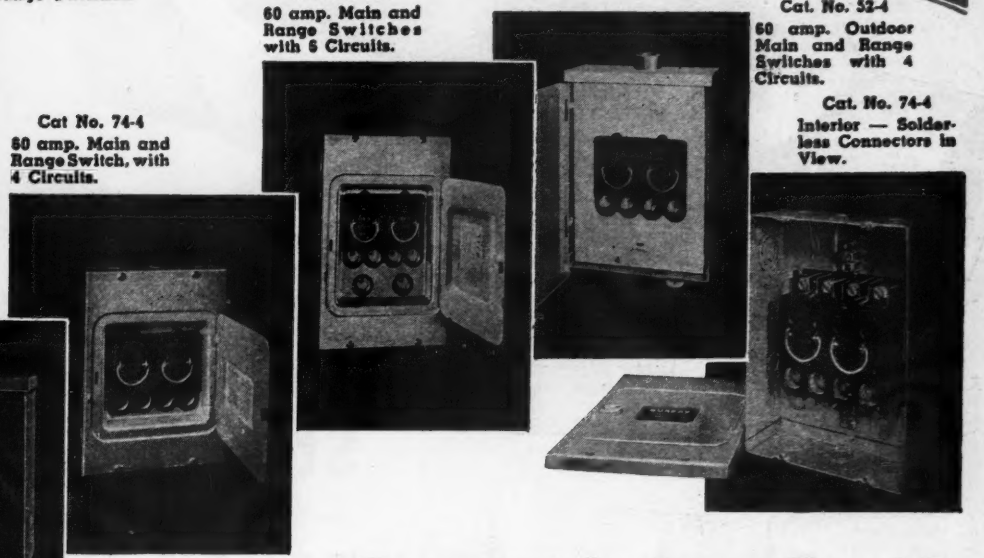
Metering equipment — Main and Range Switches.

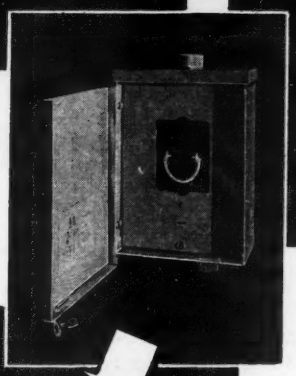
Cat. No. 74-6
60 amp. Main and Range Switches with 6 Circuits.

Cat. No. 52-4
60 amp. Outdoor Main and Range Switches with 4 Circuits.

Cat. No. 74-4
Interior — Solderless Connectors in View.

Cat No. 74-4
60 amp. Main and Range Switch, with 4 Circuits.





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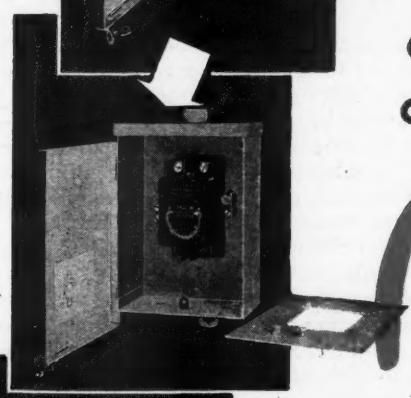
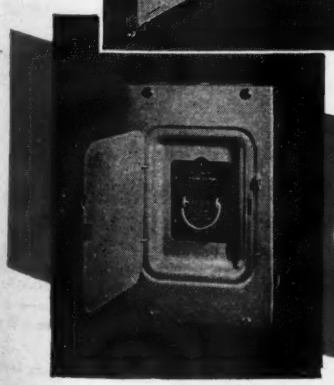
Outdoor — Service Switch — 60 amp.





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Main or Range Switch — 60 amp.

125-250 V., 3 Poles, 2 Blades, 2 Cart. Fuses, S. N.

Compact, look swell, solderless connectors, knuckle room aplenty, ample knockouts, as easy to install as hanging a picture.

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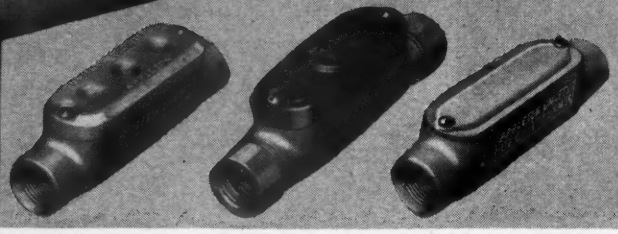
UNILETS

REG. U. S. PAT. OFF.

Designed for Every Purpose

NEW*—Twist-Lock Receptacle; plug stays in 'till it's *pulled*; can't come out until the operator *wants it out.



Available with reinforced and slightly raised blank metal covers (malleable iron or steel); or with porcelain and composition covers; or with lamp receptacle, single or duplex plug receptacles, as well as Twist-Lock receptacles.

Stronger, Lighter, Neater
because made of
TOUGH MALLEABLE IRON

Whatever the bend, or turn, or wiring problem—and every contractor meets up with plenty of tough ones in conduit work—there is an Appleton fitting specially designed to do the job perfectly. Only part of the dozens of variations in but one series of "Unilets"—Form 35—is shown here, and in that one series are both threaded fittings for rigid conduit (heavy-wall) and no-thread fittings for rigid conduit (heavy wall) also electrical metallic tubing . . . all in a full range of sizes.

That's what Appleton means by "COMPLETE LINE". . . a line so skilfully and practically designed that it ties in perfectly with the contractor's requirements at every angle.

Appleton "Unilets" are roomy, free from burrs, precision-made and finished for perfect alignment. Because they're made of strong, tough malleable iron they won't chip, crack or break, they resist settling and are not affected by temperature extremes.

Save time, build better . . . choose fittings for every job from the COMPLETE LINE . . . Appleton Fittings, "STANDARD FOR BETTER WIRING"!

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CONDUIT FITTINGS · OUTLET AND SWITCH BOXES · EXPLOSION PROOF FITTINGS · REELITE

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

Electrical Contracting

. . . Contents for August, 1946

With which is consolidated The Electragist and Electrical Record . . . Established 1901

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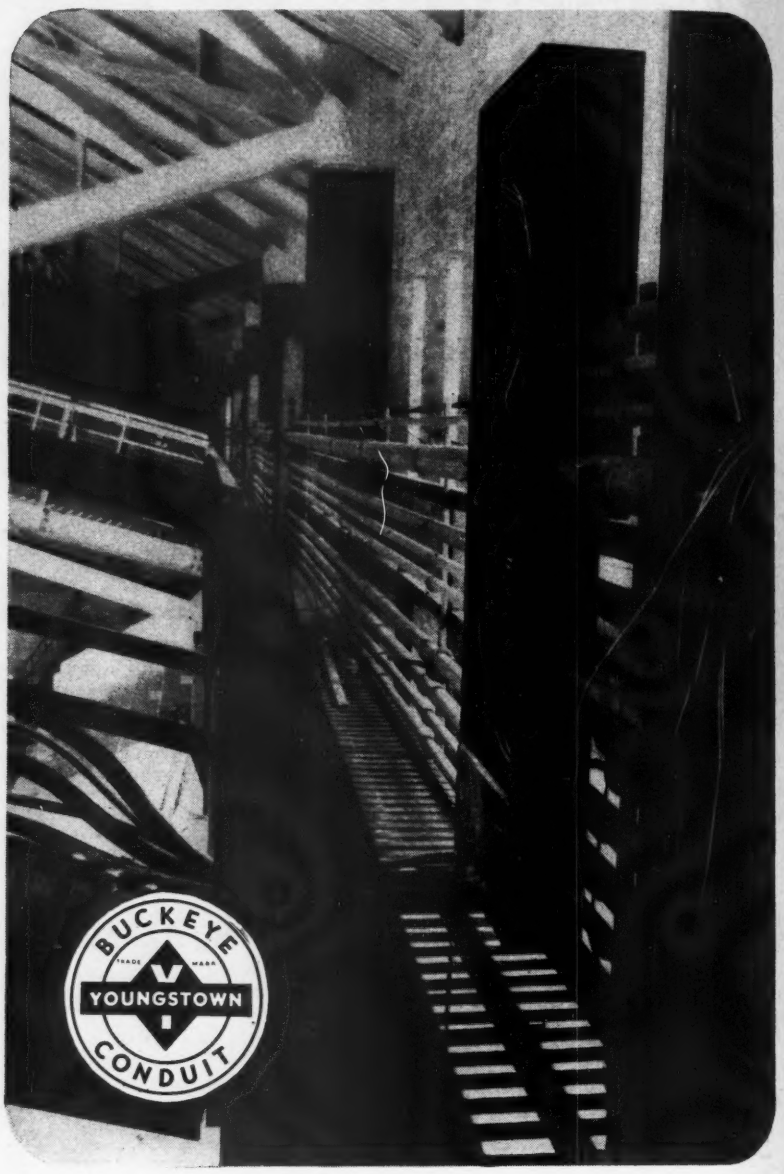
FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*

HIDING the Wiring

doesn't make it any SAFER



HIGH up, out of the way, why bother with conduit?

But "out of sight" didn't mean "out of mind" on this job. The hazards of dust and moisture are still present, even though the wiring seems to be out of the way. So the contractor protected the wiring with full-weight, rigid-steel conduit--further simplified his work by using pre-assembled conduit racks.

In new construction, under way now and being planned, you can give owners and tenants maximum protection by specifying and installing Youngstown "Buckeye" conduit. "Buckeye" has proved its dependability in unfailing, successful performance under all kinds of conditions, in all kinds of structures, for more than a quarter century.

In every respect, "Buckeye" full-weight, rigid-steel conduit meets the requirements of the National Electrical Code which says that for hazardous locations and occupancies, the only wiring system approved as moisture, vapor, dust and explosion proof is rigid steel conduit.

Local distributors in all industrial markets have Youngstown "Buckeye" conduit in stock. For their names or for other information, write, wire or phone our nearest District Office.

Ask your distributor for:
Youngstown Buckeye Conduit...Pipe and Tubular Products...Sheets...Plates...
Electrolytic Tin Plate...Coke Tin Plate...Bars...Rods...Wire...Tie Plates and Spikes.

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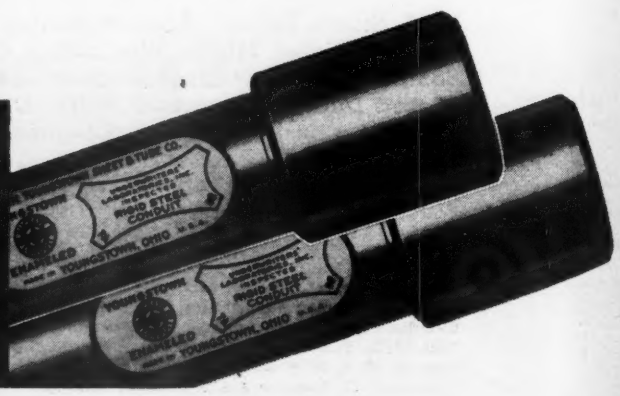
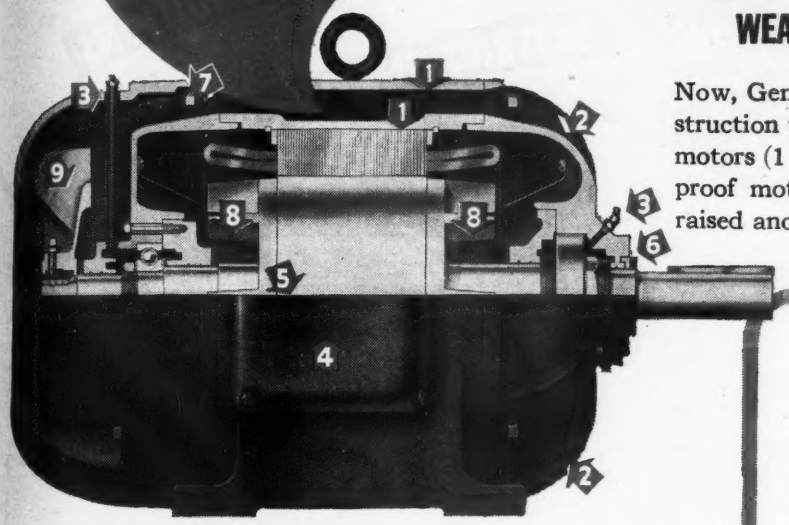


A DOUBLE WALL *Keeps trouble out*

NEW *TRI CLAD* TOTALLY ENCLOSED MOTOR IS MORE FULLY PROTECTED FROM DUST, DIRT, WEATHER, OR WHAT-HAVE-YOU . . .

Now, General Electric has applied Tri-Clad construction to its line of totally enclosed induction motors (1 to 1000 hp) and to most of its explosion-proof motors as well. *Extra protection* has been raised another notch.



FOR EXTRA-SEVERE JOBS

Applications amid dust, metal filings, coolants, or corrosive agents, where totally enclosed motors have always been required, will now have the benefit of a stronger armor, plus convenience features that simplify installation and servicing.

FOR EXTRA-WET LOCATIONS

Indoors or out, these Tri-Clad totally enclosed motors will take hosings or heavy rains without danger of shutdown. The cast-iron frame is strongly resistant to rust and corrosion.

FOR EXTRA LONG LIFE

Many motor users are making the totally enclosed motor their standard for *all* jobs—based on evidence of long-term savings. This new member of the Tri-Clad line makes this decision more logical than ever.

HAZARDOUS ATMOSPHERES

"Companion motors" to the standard Tri-Clad totally enclosed, the new explosion-proof and dust-explosion-proof types are tested and listed by Underwriters' Laboratories for Class I Groups C and D, and Class II Group E, F, and G.

THESE 9 POINTS

of new strength and serviceability put this Tri-Clad totally enclosed motor way ahead

1. A cast-iron, double-wall frame that completely encloses windings and punchings
2. Ribbed cast-iron end shields, machined to provide a tight seal, yet easily removed
3. Well proved pressure-relief greasing systems which can be packed with a long-life lubricant where advisable
4. Cast-iron conduit box diagonally split for wiring convenience (independently explosion-proof on explosion-proof motors)
5. Leads are sealed in a nonshrinking compound at the point where they emerge from frame
6. Rotating, labyrinth seal prevents infiltration of grit or liquids
7. Large, free-flowing, easy-to-clean air passages protect parts from accumulation of dust and foreign matter
8. Modern "ageless" insulation treatment includes Formex* magnet wire
9. Powerful external fan is removable, simplifying maintenance. (Nonsparking type for explosion-proof motors.)

AND IN ADDITION—compactness and short length promote ease of handling and installation.

*Trade-mark Reg. U.S. Pat. Off.

GENERAL ELECTRIC

750-357C-8058

FOR THE COMPLETE STORY

GENERAL ELECTRIC COMPANY
Apparatus Dept., Schenectady 5, N. Y.

Please send me GEA-4400, which describes the new Tri-Clad totally enclosed motor.

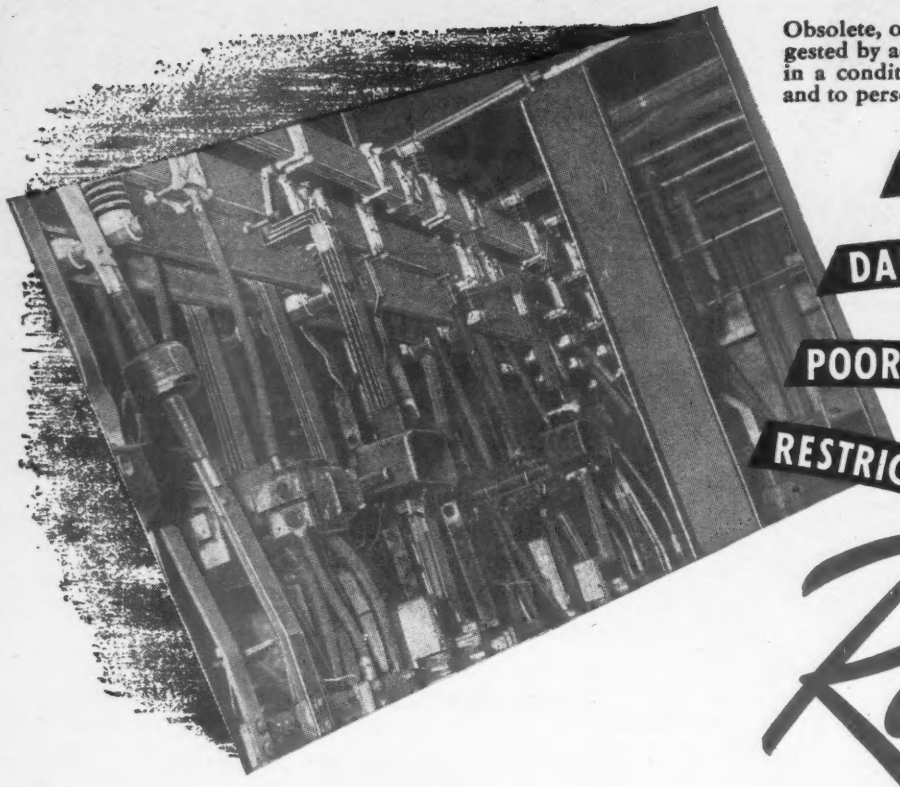
Please send me GEA-4131, "Motors and Control for Hazardous Locations."

Name.....

Company.....

Address.....

3985



Obsolete, open-type switchboard construction, congested by additions made from time to time, resulted in a condition dangerous to operating continuity and to personnel.

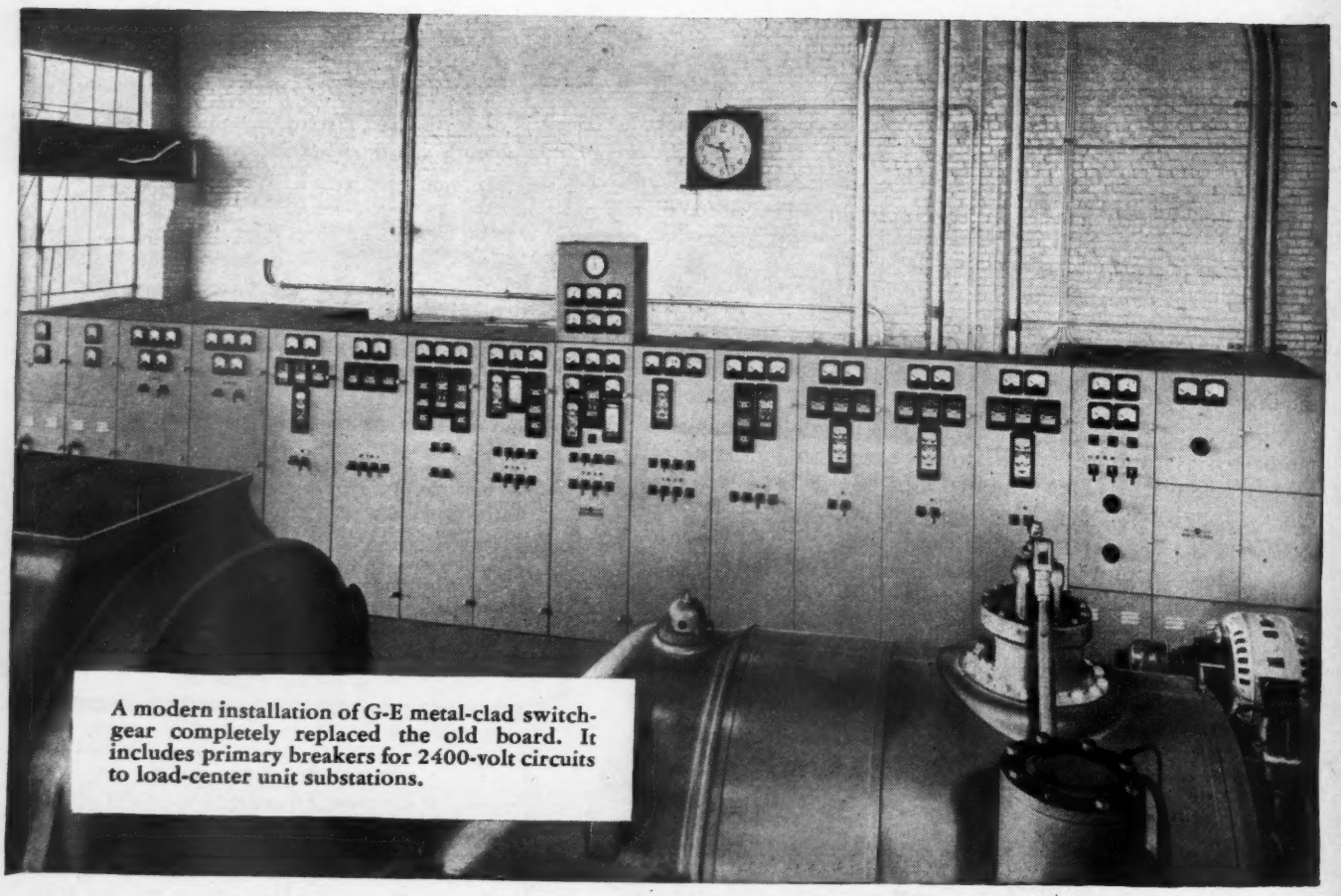
FREQUENT OUTAGES

DANGER TO PERSONNEL

POOR VOLTAGE CONDITIONS

RESTRICTIONS ON GROWTH

Removed

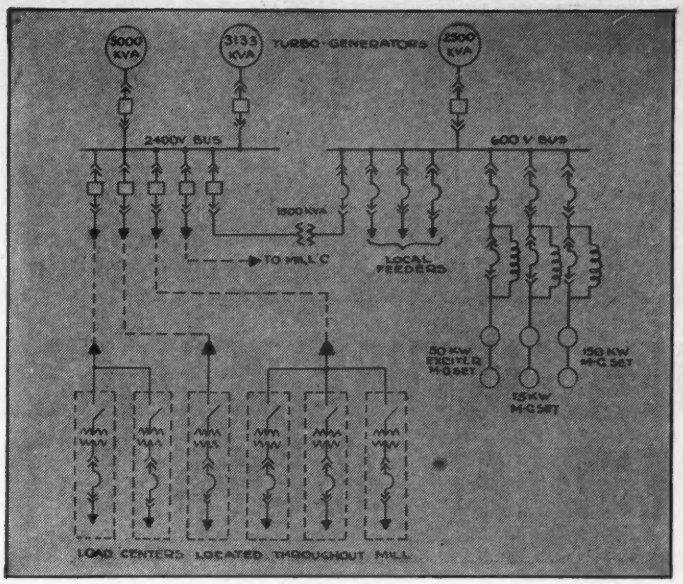


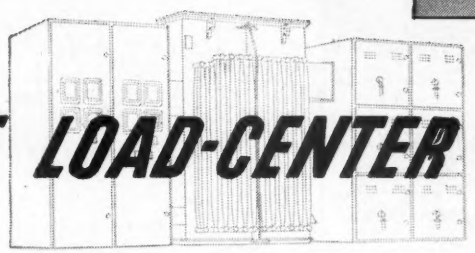
A modern installation of G-E metal-clad switchgear completely replaced the old board. It includes primary breakers for 2400-volt circuits to load-center unit substations.

GENERAL ELECTRIC

Switchgear and Load-center Unit Substations are Shown in this One-line Diagram.

Originally, the 5000-kva generator was wound for 600 volts, and all but one circuit (to mill C) was powered from the 600-volt bus. The change to 2400-volt distribution brings short-circuit amperes to a value consistent with moderate-sized circuit breakers.





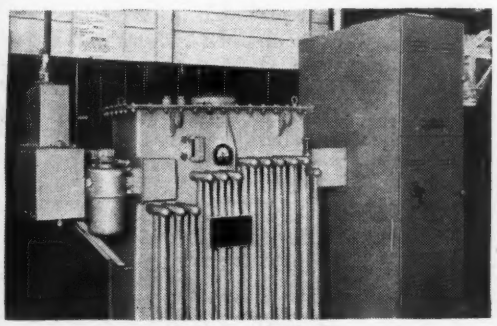
BY G-E LOAD-CENTER UNIT SUBSTATIONS

• An old, inadequate plant power system was an open invitation to trouble at this mill. Electrical outages were delaying production. Circuits and switchgear which had been added piecemeal added to the danger of inadequate interrupting capacity. In spite of large secondary feeders, the distribution of 10,000 kva at 600 volts had created unsatisfactory voltage conditions.

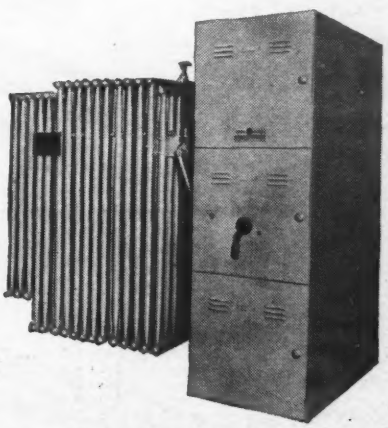
Analysis showed that further patchwork would be a costly practice. A new power distribution system, based on the use of G-E unit substations, was planned with the help of G-E engineers.

Now primary distribution is made at 2400 volts over cable that keeps voltage drop down, though it's modest in size. The powerhouse switchgear is all G-E metal-clad, equipped with magne-blast oil-less air circuit breakers. At load-center locations throughout the plant, six unit substations are installed, to step down from 2400 volts to 600. Individual circuits are fully protected by convenient metal-enclosed drawout air circuit breakers that are an integral part of the unit substation.

This new protection against outages and obsolescence is already justifying itself in power continuity and lowered costs. Why not determine, without obligation, if power-system replacement could do as much for you? Just call your local G-E representative. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Typical load-center unit substation, as installed at locations which permit short low-voltage feeders to points of power use.



Another load-center unit installed in the mill, stepping 500-kva down from 2400 volts to 600. Draw-out air circuit breakers are co-ordinated with substation size to give full short-circuit protection without excess breaker size. Substation transformers use Pyranol non-inflammable insulating liquid.

LOAD-CENTER POWER DISTRIBUTION UNITS

SYLVANIA NEWS
CONTRACTOR EDITION

AUG. *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass. 1946

NEW FIXTURE DESIGNS PERMIT SURFACE OR PENDANT MOUNTING, SINGLY OR IN ROWS

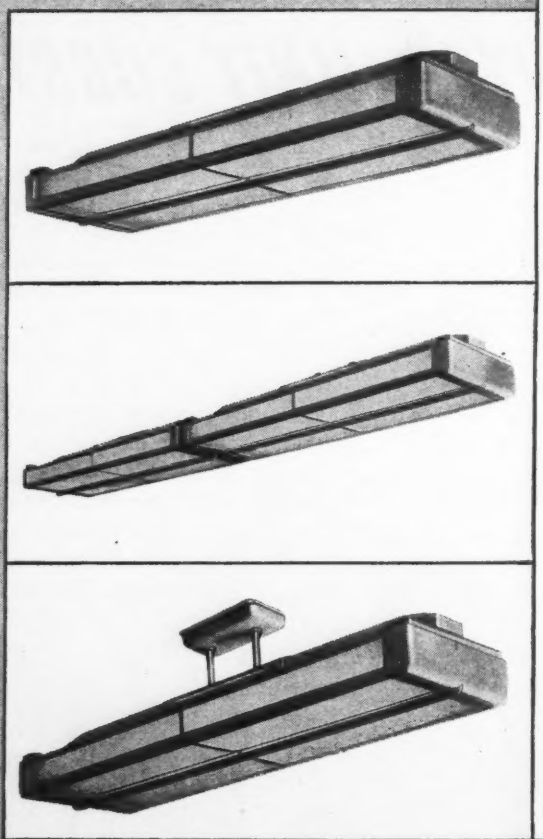
ONE FIXTURE—4 MOUNTING ARRANGEMENTS

FOR LOW, UNOBSTRUCTED CEILINGS

Direct-to-ceiling mounting is ideal where ceilings are relatively low and free from obstructions. Surface-mounted Sylvania fixtures may be arranged either individually or in continuous rows, depending on lighting requirements.

FOR HIGH OR OBSTRUCTED CEILINGS

Pendant mounting of Sylvania fixtures assures uniform alignment, and permits clearance of ceiling obstructions. Pendant mounting is also adaptable to individual or continuous-row arrangements.



Choice of Models Also Available to Meet Varied Lighting Needs

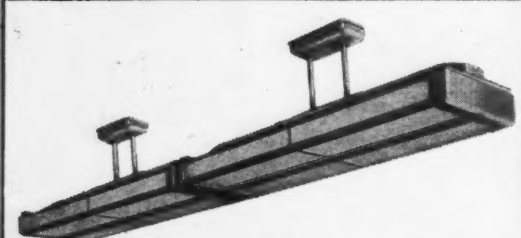
Among all the outstanding features of Sylvania Electric's new line of commercial fluorescent fixtures, contractors will find a special advantage in the ease of adaptability to different lighting requirements.

The new Sylvania fixtures are exceptionally flexible in their mounting arrangements. Every one of the 11 fixtures can be surface or pendant mounted, either singly or in continuous rows.

Moreover, the fixtures are grouped in "design families," each having one basic chassis style. This permits the use of unshielded, glass-shielded, and louver types within a single establishment, since all three types are designed to harmonize.

Both 2- and 4-lamp units of the "240" and "440" families can be used in combined mountings with the new Sylvania CP-150 spotlight fixture, to provide accent as well as general lighting.

Contractors will find this new Sylvania line easy to install, easy to maintain—and its durability and high quality will maintain customer goodwill and build repeat business. See your Sylvania distributor!



COMBINATIONS WITH SPOTLIGHTING, TOO

SYLVANIA ELECTRIC

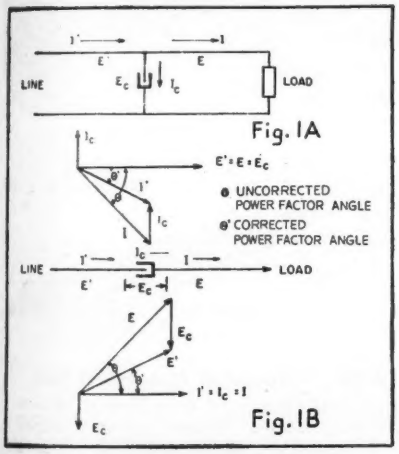
MAKERS OF FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

NO. 4

Helpful Hints on Applying Capacitors

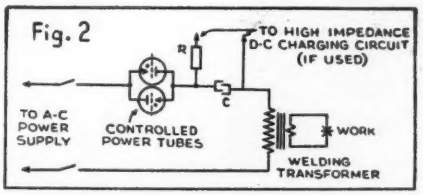
The Use of Series Capacitors for Industrial Circuits

Capacitors installed for power-factor improvement are normally connected in shunt with the load or system, providing an out-of-phase component of *current* to supply reactive kva. (See Fig. 1A.) In certain applications, however, capacitors perform another valuable function when connected *in series*. (See Fig. 1B.) Used this way, they provide an out-of-phase voltage component which has the effect of evening out voltage level under rapid intermittent loads. This is commonly known as "stiffening" the system.



DUAL-PURPOSE APPLICATIONS

In applications of series capacitors to "stiffen the system" for motor starting and the like, the capacitor kva is not high enough to raise the power factor significantly. In other cases, as on resistance-welding applications, for example, one of the functions of the series capacitor is to effectively furnish power-factor correction by compensating for the welder reactance. A shunt-connected capacitor is undesirable in this application because its output is constant and does not follow the load. The series capacitor, however, allows the feeder to handle more or larger resistance welding load.

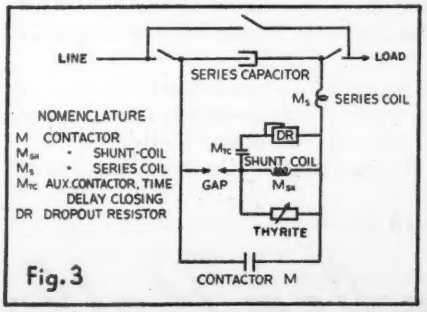


METHODS OF APPLYING SERIES CAPACITORS

When series capacitors are to be applied to resistance-welding circuits, their capacity and the circuit connections must be matched to the system of control (see Fig. 2). The following information is necessary to calculate capacity.

1. Kilovolt-amperes (volts × amperes ÷ 1000) and power factor (watts ÷ volts × amperes) under maximum working conditions.
2. Kilovolt-amperes and power factor with the electrodes directly short circuited, in order to determine maximum current and the protective requirements.
3. Line voltage and frequency.
4. Type of control, that is, mechanical contactor, synchronous or non-synchronous electronic control.
5. Duty cycle (cycles on, cycles off, pulsation per weld, and welds per minute).

The calculations required are made easy by the use of curve sheets* available for various supply voltages.

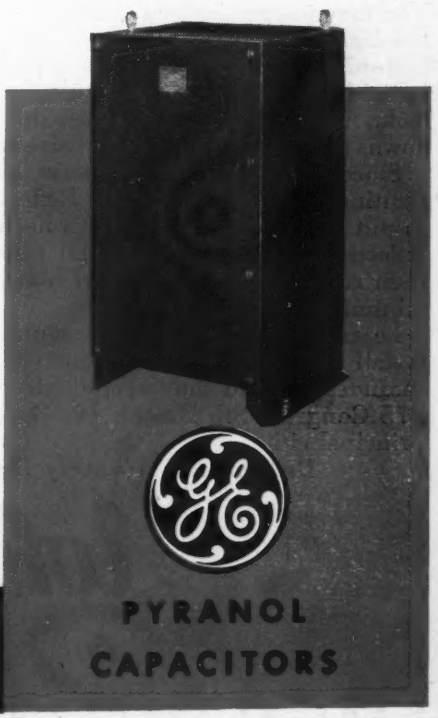


PROTECTIVE CIRCUITS FOR SERIES CAPACITORS

As the voltage across the series capacitor is a function of circuit current, it may be dangerously high for the dielectric under short-circuit fault conditions. A protective circuit may be desirable to by-pass such overloads, automatically reinserting the capacitor in the circuit when the fault current decreases to a predetermined value. See Fig. 3.

Whatever your problem in correcting power factor, eliminating light flicker or other function for which capacitors offer a remedy, G-E application engineers will be glad to work with you in selecting and applying them. Just call your local G-E representative. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

* Application of Series Capacitors to Resistance-welding Machines, reprinted from *Welding Journal*, Jan. 1943, GET-1134.

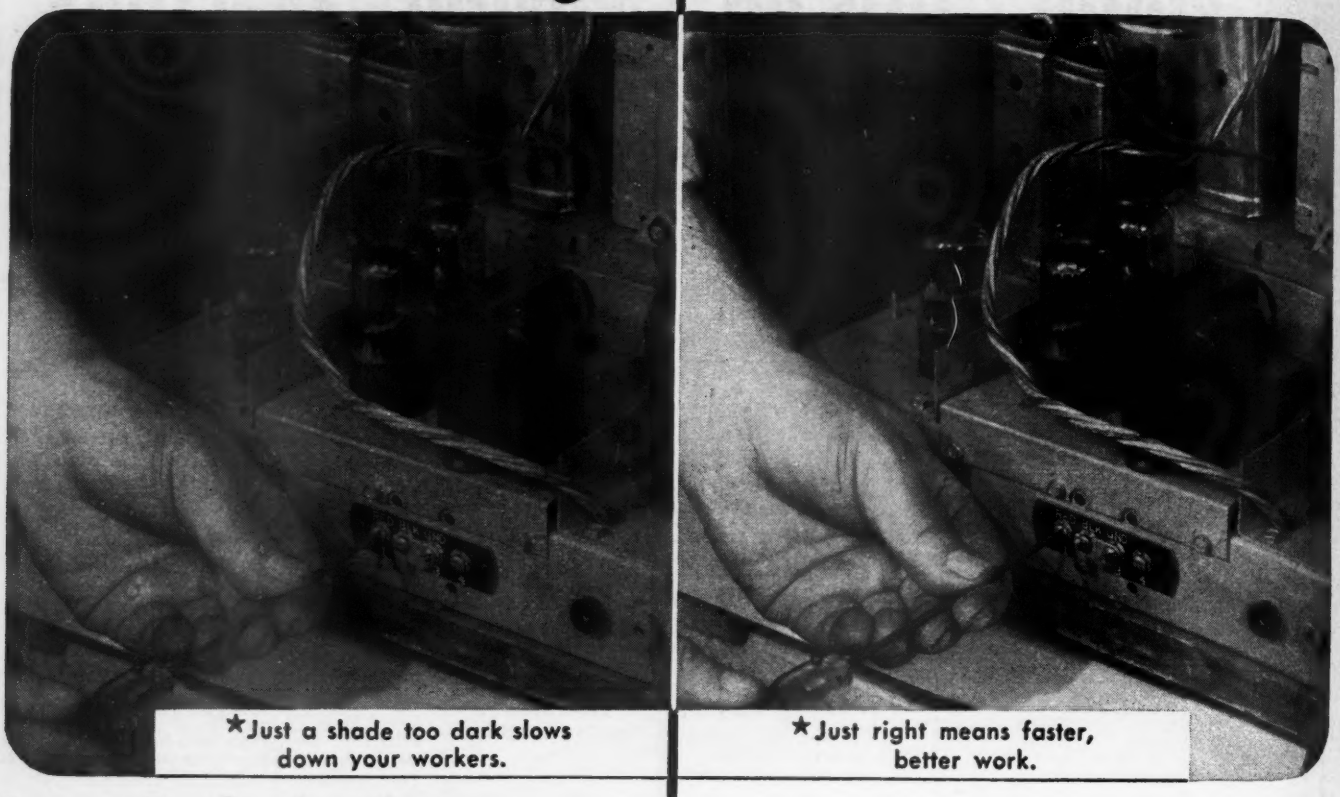


GENERAL ELECTRIC

407-105-3036

BORDERLINE VISION*

"Chiseling" Your Profits?



*Just a shade too dark slows down your workers.

*Just right means faster, better work.

Lower Production Costs With Wheeler Skilled Lighting!

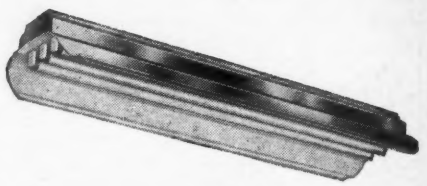
You may not realize you're being "chiseled". Lighting that's just a shade too dim may be hard to spot at a glance. But...

Borderline Vision in many a plant cuts into profits because of little, individual production slow-downs. A careful worker may take a second look. A careless one may make a mistake that means rejects . . . little slow-downs that add up to an expensive lag in production.

Since 1881 Wheeler engineers have specialized in eliminating these lighting handicaps. Wheeler Reflectors are engineered to control light – to put light to work where it's needed – on the job. Their special, high reflection factor gets maximum illumination from standard lamps. And their rugged, porcelain-enamel coated construction means long service and minimum maintenance.

Learn why better work and reduced costs are almost automatic when you install Wheeler Skilled Lighting. Write today for full details on Wheeler incandescent and fluorescent lighting fixtures. **Wheeler Reflector Co., 275 Congress St., Boston 10, Mass.** Representatives in New York and principal cities.

Distributed Exclusively Through Electrical Wholesalers



All-Steel Open-End Fluorescent Unit

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Mounts from chain or conduit, individually or in continuous runs.

RLM Solid Neck Incandescent Reflector

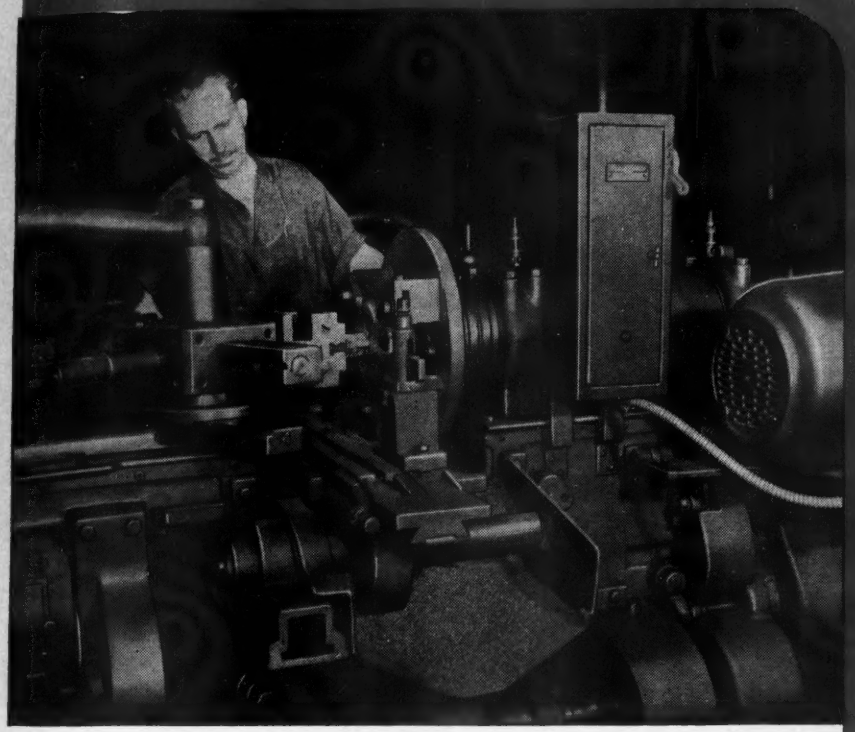
Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

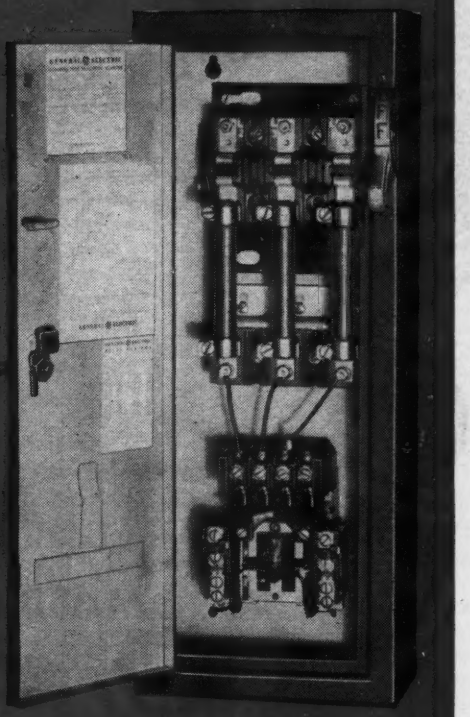
Wheeler Reflectors

SKILLED LIGHTING

MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881

300 G-E COMBINATION MOTOR STARTERS...





...give White Motor Company real protection...save time, money, too.

Magnetic starter and motor-circuit switch in *one* unit—G-E "combination" motor starters of this type give co-ordinated control to over 300 machines in the White Motor Company plant in Cleveland.

The starter shown above is installed on a lathe used in making water pumps. Others control drill presses, shapers, boring mills, grinders, and many other types of machines.

Here's Why the Combination Starter Was Chosen

- Fast-acting overload relays protect the motor controlled from overheating—and fuses protect it from damaging short circuits.
- Safety for operators is assured by interlocking doors. While the power is on, the door cannot be opened.
- Quick servicing and availability of repair parts is made possible by G.E.'s broad network of sales outlets.

Wide Field of Application

This motor company represents just one of the many different industries in which G-E combination starters are at work today. Why not give the advantages of these compact, time-saving starters to *your* plant. Our engineers will be glad to help with your application. Get in touch with our local office today. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

HOW YOU SAVE...

. . . TIME. Instead of buying two devices, you order and install only one. Mounting time is cut as much as 40 per cent.

. . . SPACE. Compact combination starters can be mounted in small unused places near to or remote from the operator.

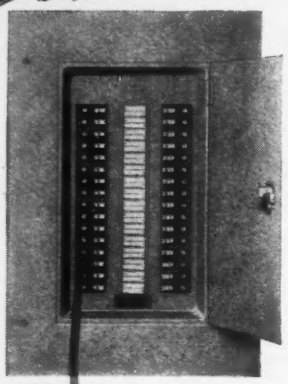
. . . MONEY. The list price is slightly more than for two separate devices, but the difference is more than made up by savings in wire, conduit, and fittings.

MORE INFORMATION about combination starters is given in our Bulletin GEA-3715A. Ask our local office for your copy.

GENERAL ELECTRIC

676-200-8910

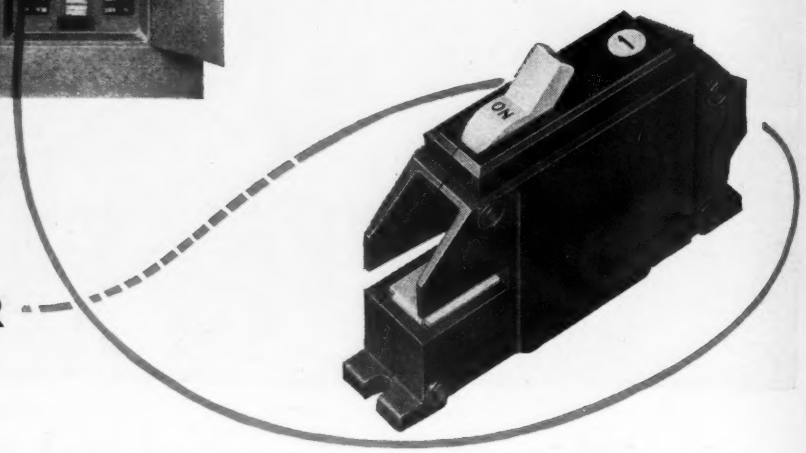
THERMAL MAGNETIC ACTION



--- gives you FASTER MORE POSITIVE CIRCUIT PROTECTION

THERMAG

AUTOMATIC CIRCUIT BREAKER PANELBOARD



There is no need to worry about short circuits . . . dangerous overloads . . . burned out equipment . . . and other similar costly and irritating service interruptions . . . with Ⓕ Thermag Automatic Circuit Breaker Panelboards.

Built from standard units and enclosed in attractive easy-to-install steel cabinets, these modern Underwriters' Laboratory-approved Panelboards are ideal for schools, commercial and industrial installations.

The heart of these modern and efficient panelboards is the Ⓕ Thermag (Thermal-Magnetic) Circuit Breaker which insures positive circuit protection by combining two important functions in one working unit . . . a thermal action that ignores harmless overloads and temporary surges of current, plus a magnetic action that instantaneously interrupts current at the first sign of short circuit or dangerous overload.

Easy to operate, requiring only the "flip of the handle" to restore service . . . when the trouble is eliminated . . . panelboards with Ⓕ Thermag Automatic Circuit Breakers are today's answer to tomorrow's service problem. So insist that your next panelboard be an Ⓕ Thermag Automatic Circuit Breaker type.

Ⓕ Thermag Circuit Breaker Panelboards are available in standard and narrow column types, also dust-tight and vapor-proof construction panelboards. The type AC Thermag Circuit Breakers are furnished in 15, 20, 25, 35, and 50 amp. capacities for 120 volts AC — single or double pole. Panelboard assemblies have 4 to 42 branch circuits with 115-230 volt, 3-wire, or 120-208 volt, 4-wire solid neutral mains.

For more complete information regarding specifications and costs, write for Bulletin No. 67.

TO RESTORE SERVICE

"Simply Flip the Handle" TO ON POSITION!

(After Removing Cause of Trouble)

EST. 1891 — THE SIGN OF A BETTER JOB

Frank Adam

PANELBOARDS

FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

- BUSDUCT
- PANELBOARDS
- SWITCHBOARDS
- QUIKHETER
- SERVICE EQUIPMENT

"For This Job, Give Me Two Things in a Motor"

. . . said the Power Plant Engineer

"To Drive Boiler Feed Pumps, motors must first be *simple.* For example, take these three Allis-Chalmers 800 hp, 3600 rpm motors. They're 2-pole, squirrel-cage, single winding machines . . . with practically fool-proof rotors and sleeve bearings. But second, and even *more* important . . .

They've Got to be Dependable! Here's what I mean. These same motors have given us 17 years of uninterrupted service. We've had to order replacement parts for them only twice . . . at a total cost of less than $12 a year. We call that *good performance* . . . the kind we've come to expect of *all* your motors!"

Frankly, Mr. Reader, we *are* mighty proud of our 2-pole motors. We've been developing them for high-speed requirements like this from the very earliest. Licked a lot of problems too. Like cutting down noise through better design . . . reducing windage noise with proper baffling, and curbing magnetic noise. . .

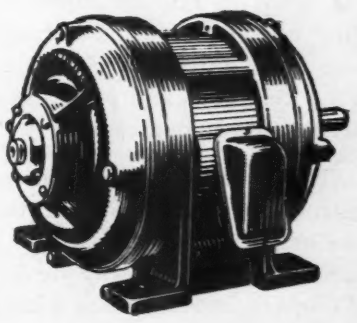
We're Getting Better Efficiencies and power factor . . . and lower starting kva, through improved squirrel-cage design. We've designed bearing brackets generously for greater structural rigidity. In fact, all the way around you can expect to find long life and low maintenance built-into our motors!

Yes, "A-C" Means Long Life in Motors!

REGARDLESS of size or type you'll be money ahead with Allis-Chalmers motors. For at A-C you can expect and *get* the same careful engineering, generous design and long-life operation that thousands of motor buyers have come to rely upon through the years.

And remember . . . while many jobs call for special or modified motors, there are *many more* that can be solved with *standard* motors . . . at less cost . . . and often with saving in time! ALLIS-CHALMERS, MILWAUKEE.

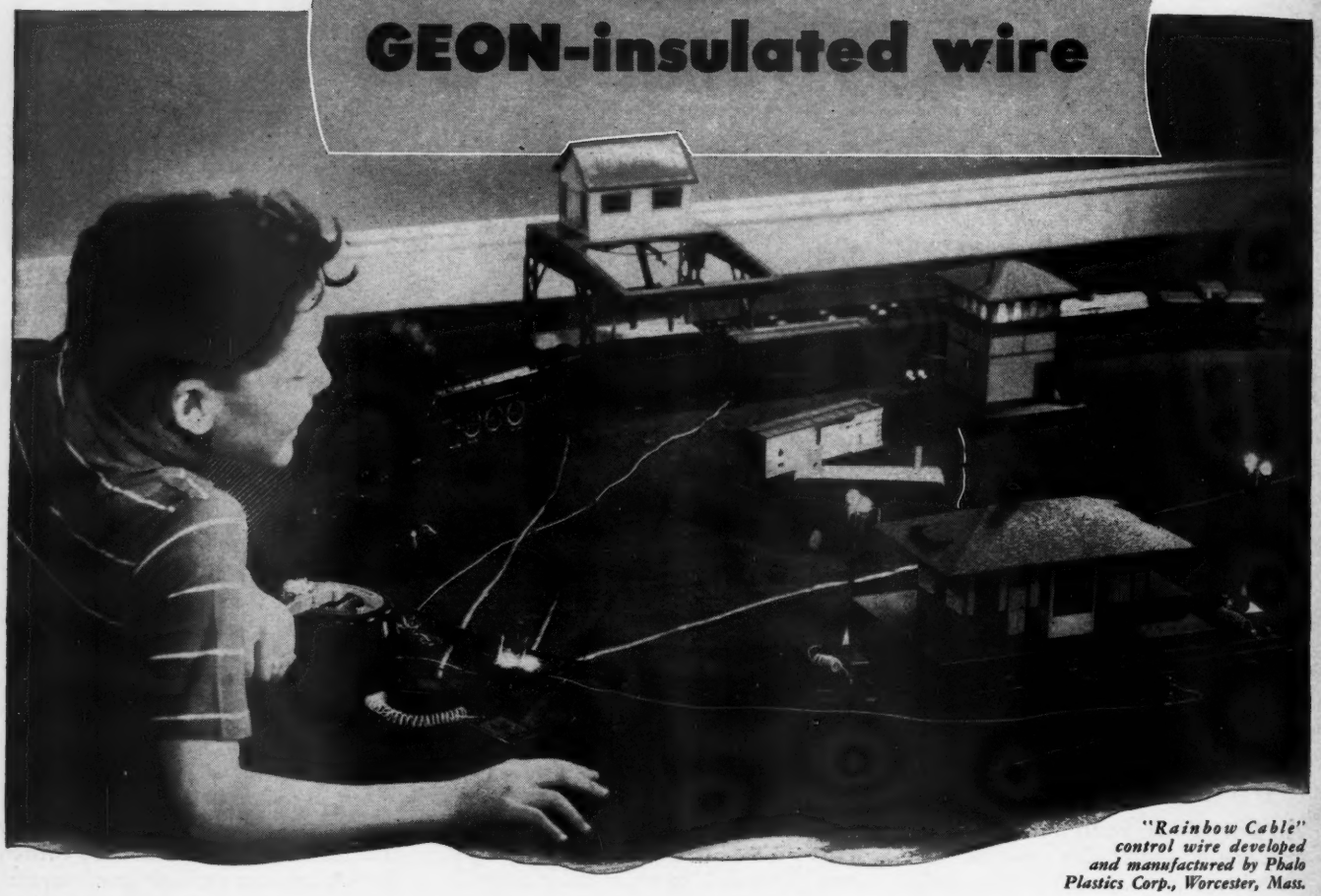
A 2082



ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

He runs his road with GEON-insulated wire



"Rainbow Cable" control wire developed and manufactured by Phalo Plastics Corp., Worcester, Mass.

GEON's *advantages make it ideal insulating material for instrument, home, industrial and utilities wiring*

THE things that Bill used to do with his hands to keep his railroad running—coupling and uncoupling cars, loading and unloading, turning switches—are all done by electricity on the modern American Flyer that huffs and puffs and belches smoke just like its full-sized counterpart.

That calls for connecting wires that are easy to identify, that stand rough usage, that won't crack, get gummy or peel, that will keep fire hazards to a minimum. That's why the A. C. Gilbert Company selected wire with insulation made from GEON. It can be brilliantly colored in a wide range, it wears indefinitely, resists aging and ozone, and is self-extinguishing—won't support combustion.

These and other properties of insulation made from GEON have earned it an important place in every part of the electrical industry. The thinner coating of insulation made possible by GEON's electrical properties permit more conductors per conduit. Resistance to oil and grease, acids, alkalis, moisture, heat, cold, and most other normally destructive factors mean that insulation made from GEON can be used *everywhere.*

The next time you order wire—for manufacturing, home, or industrial wiring—be sure to specify wire insulated with GEON, now being made by leading wire and cable manufacturers. Or for information about special applications please write Department Y-8, B. F. Goodrich Chemical Co., Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

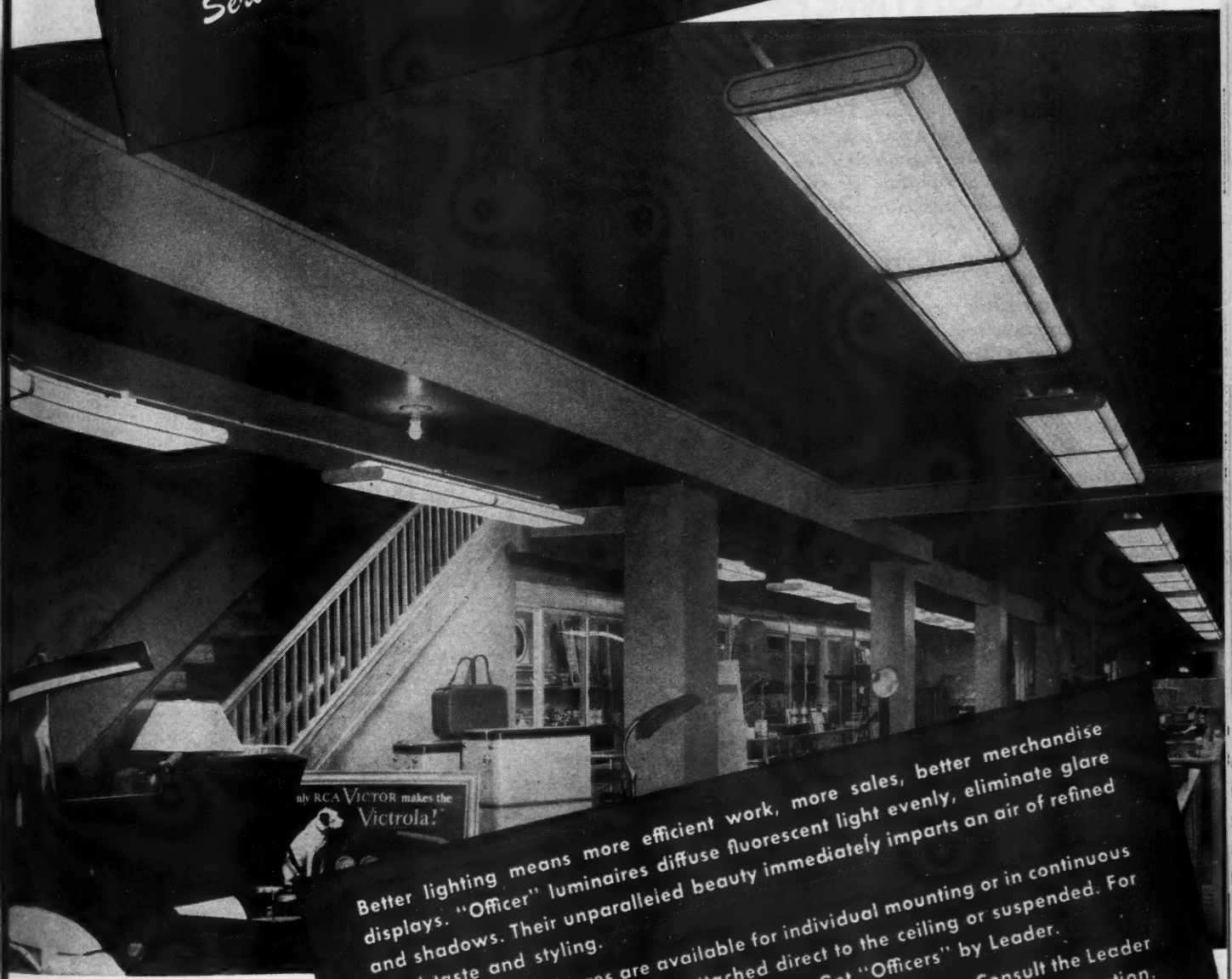
Geon
Polyvinyl Materials
A TRADE MARK OF B. F. GOODRICH CHEMICAL COMPANY

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

Leader

Series of Fluorescent Luminaires . . . Mean



Better lighting means more efficient work, more sales, better merchandise displays. "Officer" luminaires diffuse fluorescent light evenly, eliminate glare and shadows. Their unparalleled beauty immediately imparts an air of refined good taste and styling.

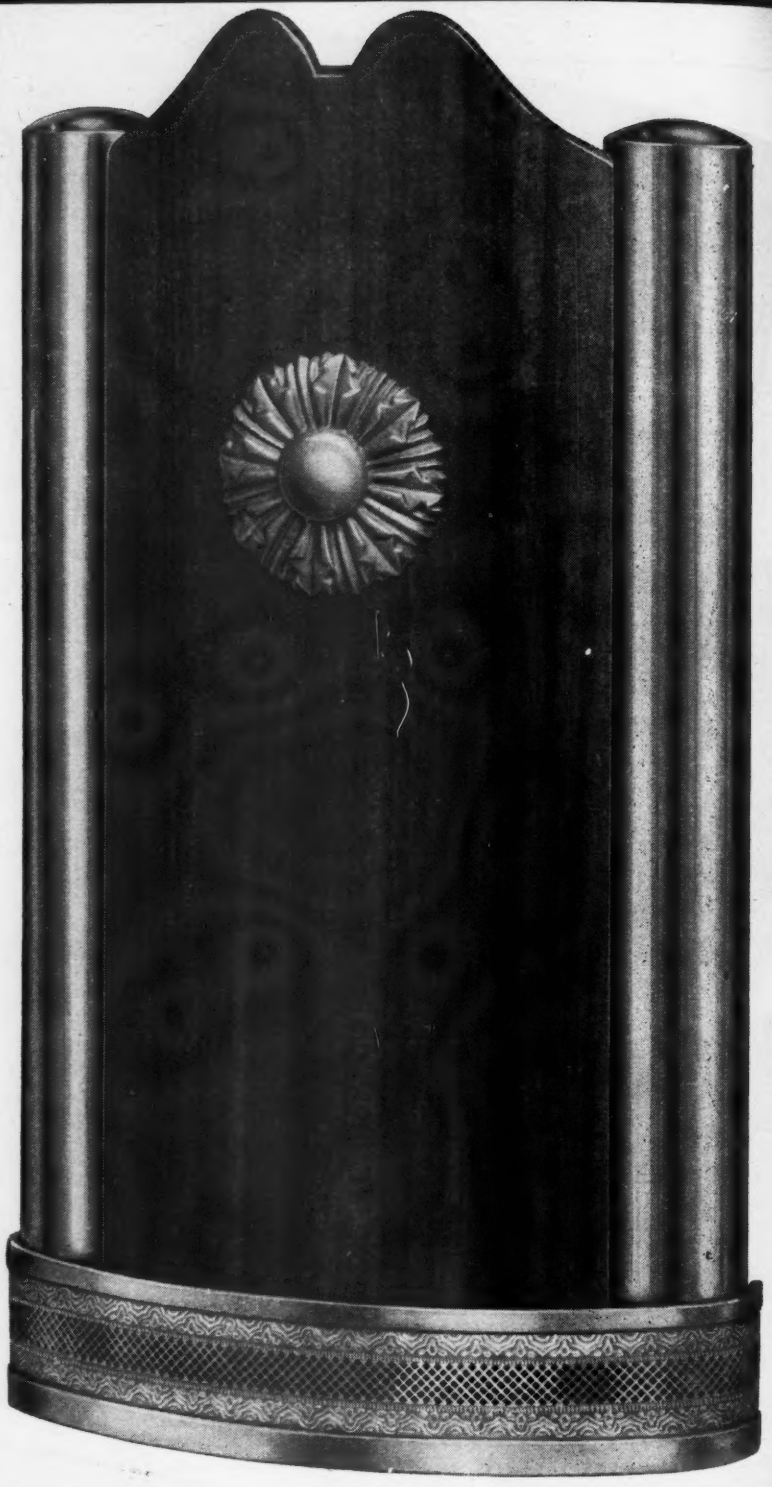
Leader "Officer" fixtures are available for individual mounting or in continuous runs. Optionally, they may be attached direct to the ceiling or suspended. For fluorescent lighting at its best, get the best. Get "Officers" by Leader.

Only better wholesalers carry Leader fluorescent luminaires. Consult the Leader representative in your area, today. He'll gladly give you any desired information.

LEADER ELECTRIC MANUFACTURING CORPORATION
6127 NORTH BROADWAY • CHICAGO 40, ILLINOIS
West Coast Factory . . . 2040 Livingston Street
Oakland 6, California

It pays to plan NOW for wiring the

NUTONE "SYMPHONIC" DOOR CHIME!



Clients appreciate NUTONE Chimes. Even more popular will be the new 8-tone "Symphonic," because no other chime so compact (only 14¾ inches high) has ever been perfected for sounding eight full Westminster notes! The "Symphonic" is stunning walnut-finish and brass, too, and lists at $24.95.

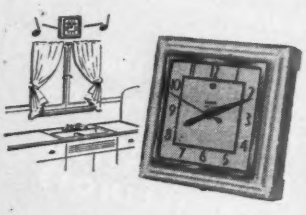
So plan NOW to wire this newest of the famous NUTONE Chimes. It is self-contained to make wiring easy, adaptable to any type of construction. And wiring during construction will make final installation quick and clean, cost you less, assure you of clients grateful for your careful planning.

Write your nearest NUTONE office for wiring directions and suggested installation sites for this and other NUTONE Chimes. *NUTONE, Incorporated, Merchandise Mart, Chicago 54; 200 Fifth Ave., New York 10; 931 E. 31st St., Los Angeles 11; or Terminal Sales Bldg., Seattle 1.*

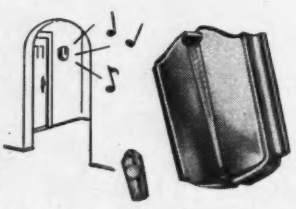
WORLD'S LARGEST MAKER OF DOOR CHIMES

NUTONE TRADE MARK

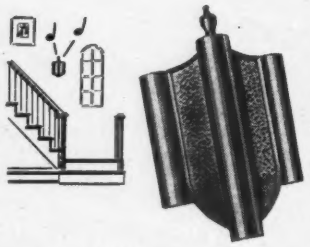
...better living means better listening, too!



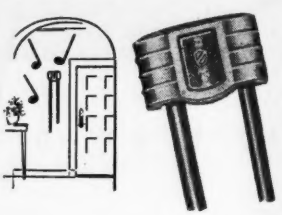
The TIME-CHIME . . . for kitchens or hallways. A fine NUTONE 2-door chime and new *Telechron* electric clock. List, $14.95.



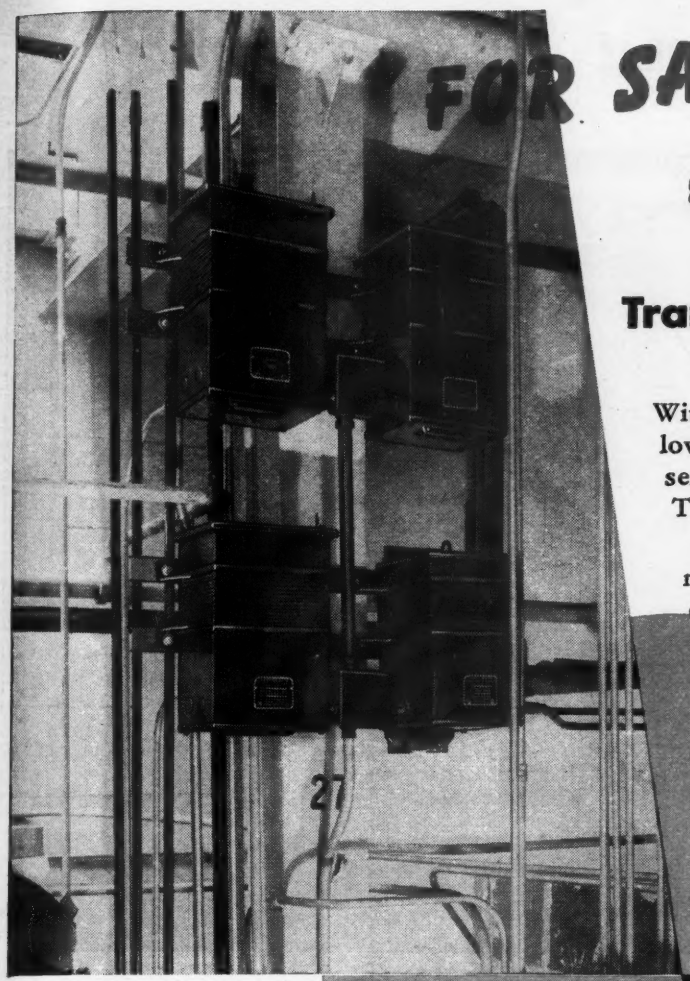
The JEWEL . . . modern all-brass 2-door chime for living room or hallway. Packed with matching Jewel Push Button. List, $9.95.



The MT. VERNON . . . a 2-door all-brass Colonial chime for stairway, hall, or living room installation. List, $7.95.



The IMPERIAL . . . a 2-door long-tube chime (38¼" overall), well suited for foyer or living room niche mounting. List, $7.95.



FOR SAFETY AND ECONOMY

● Use of Power Circuit Transformers Widely Extended

With the higher entrance voltages now in vogue—lower voltage circuits for lights and appliances are served through Jefferson Electric Power Circuit Transformers placed at various locations.

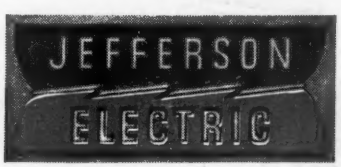
With the greater use of 230-volt and 460-volt motors—the 115-volt service for the control circuits is likewise furnished by these same type transformers installed adjacent to or directly on the machine tool.

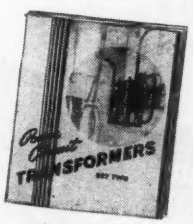
Group of four Transformers serving 230-Volt secondary current for rectifiers and A.C. to D.C. converters in special product testing and experimental rooms. Primary 460-Volt

Jefferson Electric Transformers Have Years of Performance History

Installed in many of the country's foremost manufacturing plants—performance records reveal many years of successful operation. They are known for their uniformity of quality, superior construction, and conformity with the very latest engineering practice.

Just off the press, Bulletin 461-PCT, contains suggestions and installation applications. A copy is yours for the asking. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.





Power Circuit—Dry Type *Write for New Bulletin 461-PCT*

TRANSFORMERS

Transformer with built-in Overload Circuit Breaker located near motor and control push button station. Motor operates at 230-Volts—controls at 115-Volts.

"Island Hopping" *installations*

are jobs for PANCAKE

Today people with desk jobs are no strangers to machinery. They may have power driven calculating machines, bookkeeping machines, dictating machines, electric typewriters or other special equipment right on their desks . . . and all requiring electric power "delivered-on-the-job". Usually this involves an "island hopping" wiring problem . . . overfloor wiring for power and light that is best handled with PANCAKE Wiremold Overfloor Wiring Systems . . . flat as a pancake, strong as a bridge, trip-proof, with low ramp angle. With PANCAKE and a few well designed fittings you can meet all such needs with assurance of easy extension or relocation for future changes. PANCAKE is also the approved method of connecting telephones to desks, etc., and meets all telephone company requirements. Write for bulletins and data sheets giving all details.

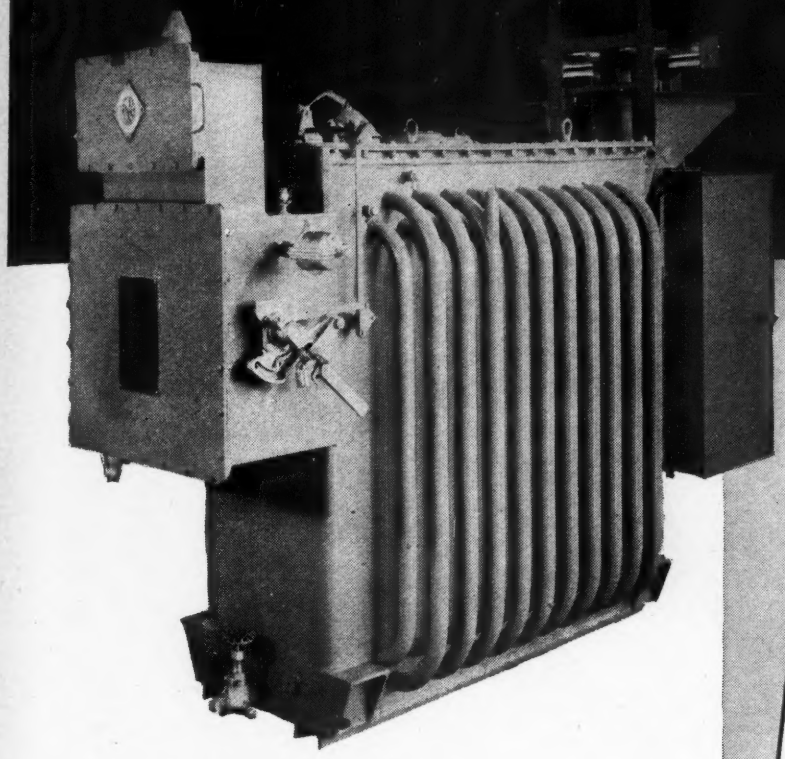
THE WIREMOLD COMPANY
HARTFORD 10, CONN.

MORE than Adequate Wiring . . . from Panel Box to Outlet.

SOLD THROUGH ELECTRICAL WHOLESALERS . . . INSTALLED BY ELECTRICAL CONTRACTORS . . . EVERYWHERE!

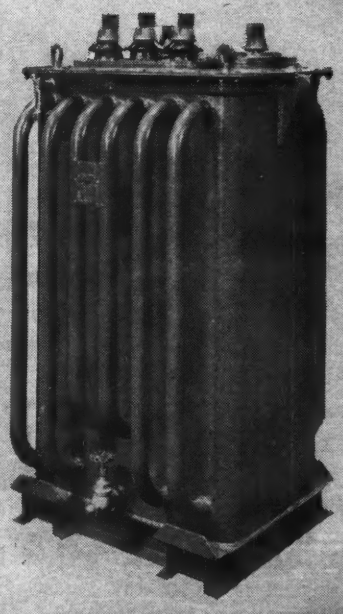
AMERTRAN ABESTOL-IMMERSED TRANSFORMERS

for *safe*, efficient distribution service



AmerTran Abestol Transformers meet the full requirements of the National Electrical Code. They *do not* require fireproof enclosing vaults. Since there are no installation restrictions, they can be installed as close to the center of load as desired.

- **Non-Inflammable**
- **Require no vaults**
- **Save installation space**
- **Reduce copper costs— locate at load center**
- **High efficiency**



ABESTOL, the non-inflammable AmerTran liquid used in these transformers, has high dielectric strength and efficient cooling properties. It does not generate inflammable gases.

Abestol Transformers are particularly suited to locations where the hazard of fire must be avoided. At the same time they afford other distinct advantages. Installation usually is simpler and less expensive than that required for oil-filled types. They can be installed indoors or outdoors, on platforms, directly at the load center. They make possible substantial savings in length and cost of secondary lines.

Abestol Transformers can be supplied for power and distribution service in all practicable ratings and ratios. Write for further information.

AMERTRAN

REG. U. S. PAT. OFF.

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

AMERICAN TRANSFORMER COMPANY

178 Emmet Street • Newark 5 • New Jersey

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMER TRAN

Versatility in Lighting

CEILINGS UNLIMITED

Lighting which opens up new vistas in architectural design — CEILINGS UNLIMITED — for stores, offices, schools, factories, and public buildings, is provided by MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS. The patented MILLER CEILING FURRING HANGER makes possible suspension of ceilings from the lighting system and arrangement of units in continuous rows, blocks, or patterns, as desired . . . speeds installation . . . 50 to 75% less supports from structural ceiling needed. Its wireway assures 50% less wiring cost, and up to 80% less conduit and conduit fitting cost. MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS set LIGHTING on a new, high pinnacle of accomplishment.

THE MILLER COMPANY • MERIDEN, CONN.

Illuminating Division

- HEATING PRODUCTS DIVISION
- ILLUMINATING DIVISION
- FOUNDRY DIVISION
- ROLLING MILL DIVISION

MILLER
SINCE 1844

Burndy Qikluqs

For wires and cables with a *happy Ending*

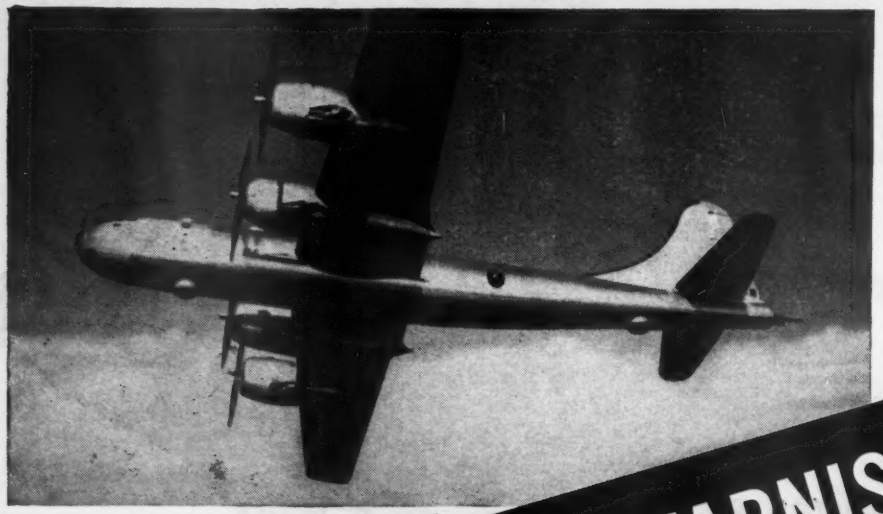
Neat, compact, *unit* assemblies. Equipped with oversize studs to prevent stripping or distortion. Eleven sizes take 40 cable sizes. Tongues for 1, 2 or 4 holes, blank and special. Straight, 45°, 90° or right angle. Single or double clamping elements for single or multiple cables. NO SPECIAL TOOLS FOR INSTALLATION.

Catalog 41 describes all Qikline and other Burndy electrical connectors. SEND FOR YOUR COPY. Burndy Engineering Co., Inc., 107-DBruckner Blvd., New York 54, N. Y.

Headquarters for CONNECTORS

Burndy

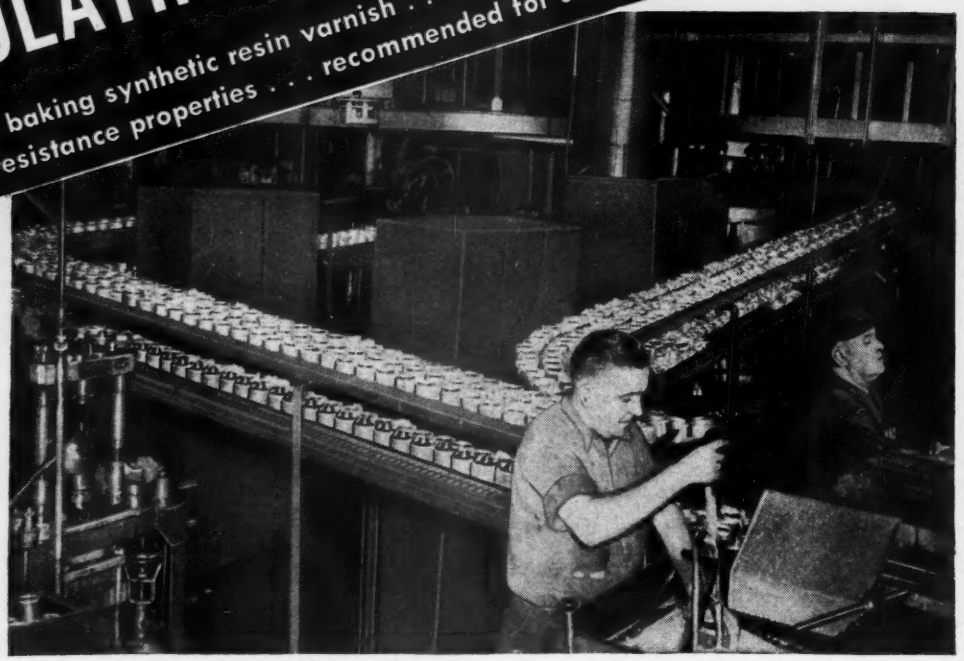
No electrical equipment can be any better than its insulation



This insulating varnish helped revolutionize fractional horsepower motors for warplanes...

G-E INSULATING VARNISH 9535

A clear baking synthetic resin varnish . . . exceptional bonding and moisture resistance properties . . . recommended for small electric motors.



. . . and the same varnish can make washing machine motors better

SPECIFY G-E Insulating Varnishes with confidence. Now available to all industry, these products have been proved in a myriad of war applications. General Electric offers you the benefit of huge productive capacity . . . 45 years of experience in varnish research and manufacture . . . expert technical service. And strict G-E Quality Control assures uniformity of product in every shipment. For full details consult your local Merchandise Distributor. Or write direct to Section RIMA-865, Resin and Insulation Materials Division, Chemical Department, General Electric Co., Schenectady 5, N. Y.

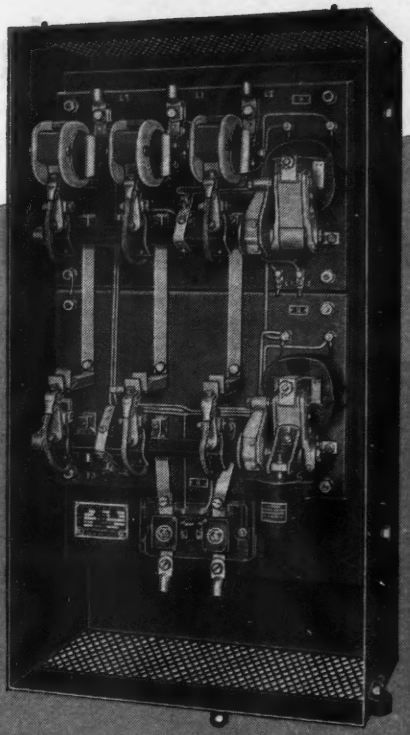
GENERAL ELECTRIC

CD46-15

G. E. OFFERS A COMPLETE LINE OF INSULATING MATERIALS

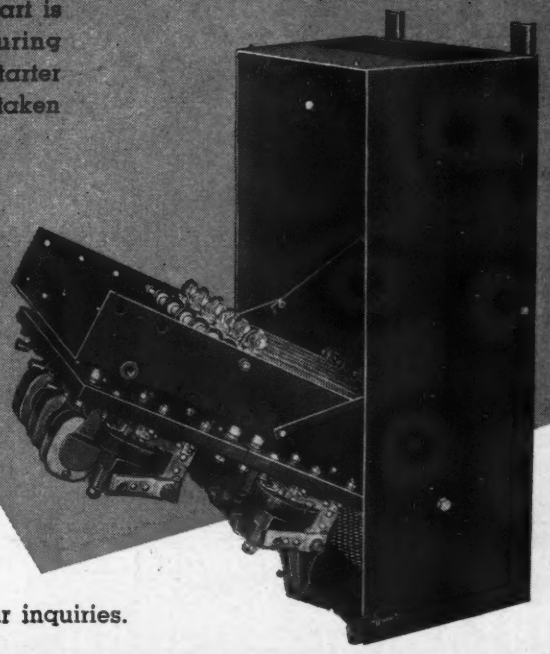
"3C" Bulletin 6080 A. C. MAGNETIC STARTERS

For Dependable Low-Voltage Starting of Squirrel Cage Induction Motors



Bulletin 6080 Starter, Size 4 Front Cover Removed Showing Swing Out Feature which provides ease of inspection of resistors.

For application on drives where mechanical limitations require reduced torque on starting, or where power restrictions limit amount of starting current, "3C" Bulletin 6080 Primary Resistor type A.C. Magnetic Starters are recommended. Constantly increasing torque is developed by the motor as it comes up to speed—a smooth start is produced since motor circuit is not interrupted during transfer from reduced to full voltage. Moreover, this starter does not reduce power factor at which power is taken from line during starting period.



Features of this starter include:

- **Reduced voltage starting.**
- **Edgewound accelerating resistors.**
- **Definite time acceleration.**
- **Motor overload protection.**
- **Copper-to-copper contacts.**
- **Rolling and wiping action on opening and closing keeps contacts clean.**
- **Arcs quickly extinguished by blowouts.**
- **Swing out feature for wall mounting sizes.**
- **Mechanical and electrical interlocks on reversing types.**

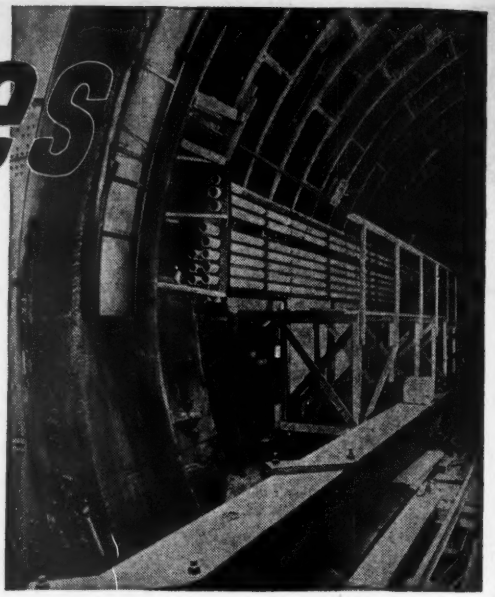
Our distributors and district offices will welcome your inquiries.

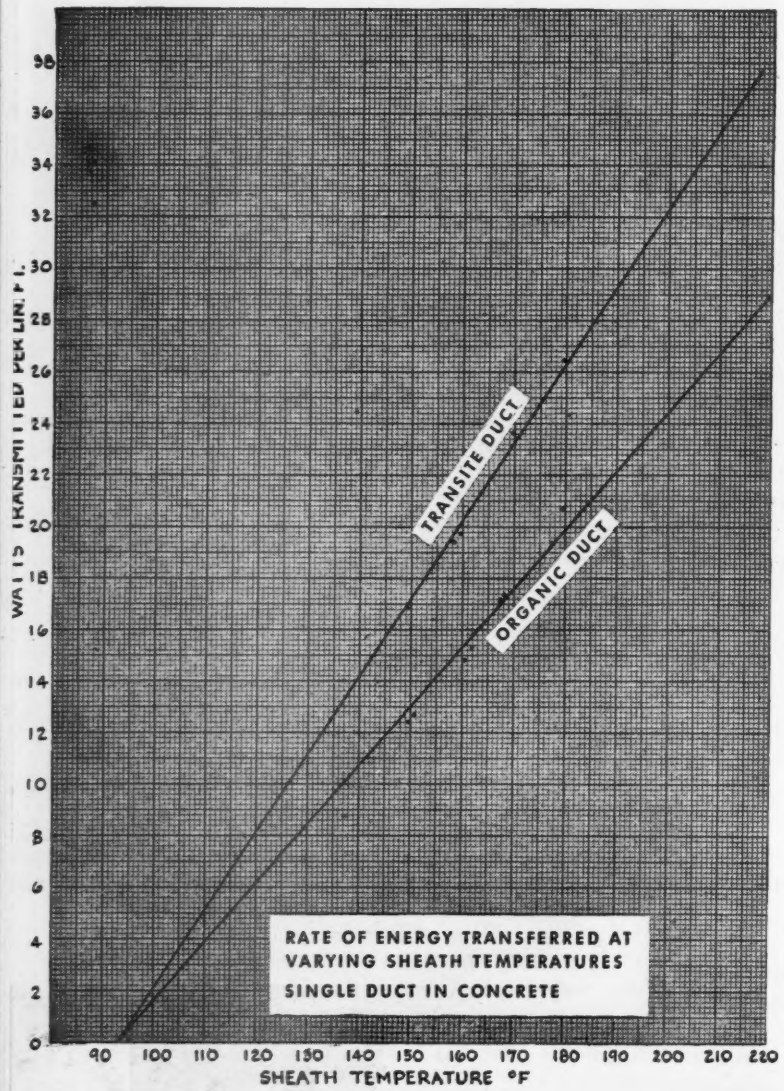
THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

Cooler Cables

proved in the laboratory and in operation with Transite Ducts





AS THE GRAPH shows, Transite Ducts made of asbestos and cement have a much higher rate of heat transfer than organic conduit. Tests in the Johns-Manville Laboratories, later applied to specific field conditions, proved that Transite Ducts dissipate I_2R losses 13% faster than other ductways tested, thus keeping cables cooler.

In actual operation, this means that cables installed in Transite Ducts have a higher inherent load capacity, or, carrying rated loads, will run cooler, thereby reducing copper losses and increasing cable insulation life.

Transite Ducts, made of asbestos and cement, are strong, immune to rust and rot. They are incombustible and unaffected by electrolysis or galvanic action. A permanently smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly and economically installed. In addition, a variety of fittings simplifies even the most complicated installations.

For full information write for Data Book DS-410: Johns-Manville, 22 East 40th Street, New York 16, N. Y.

The chart shows why Transite Ducts keep cables cooler than ordinary organic ducts.

Johns-Manville **TRANSITE DUCTS**

CONDUIT for use without concrete

KORDUCT for concreting in

JOHNS-MANVILLE JM PRODUCTS

Tapes that are Tops

Not only are PANTHER and DRAGON Friction and Rubber Tapes attractively packaged for immediate sales appeal, but their physical and dielectric qualities make them tapes that bring repeat orders. Wrapped and sealed individually in cellophane, these widely-advertised tapes have good working characteristics, stay fresh and are free from raveling. There is guaranteed footage in PANTHER and DRAGON Tapes, which fully meet ASTM and Federal Emergency Specifications.

PANTHER and DRAGON Friction Tapes have high dielectric, tensile strength and adhesive qualities. PANTHER and DRAGON Rubber Tapes have this same combination plus the characteristic of fusing securely.

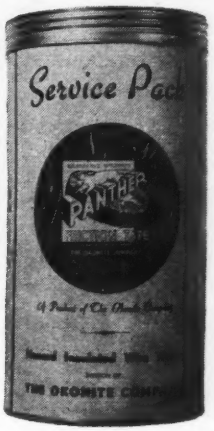
PANTHER

Friction Tape	*Rubber Tape*
No. 8 roll 60 ft.	No. 8 roll 23 ft.
No. 4 roll 29 ft.	No. 4 roll 11 ft.
No. 2 roll 14 ft.	All tapes come in standard 3/4" width.
No. 1 roll 6 ft.	Other widths made to order only.

DRAGON

Friction Tape contains 165 feet per pound of 3/4" width.
Rubber Tape contains 30 feet per roll of 3/4" width.

PANTHER Handy Package
Holds 10 individually wrapped and sealed rolls of friction or rubber tape in No. 8 or No. 4 sizes for counter or shelf.



PANTHER Service Pack
Holds 10 rolls of No. 8 PANTHER Friction Tape only, each roll wrapped and sealed individually.

PANTHER, DRAGON and EXCELLO Tapes are sold only through recognized wholesalers. Further details on these tapes or the name and address of your nearest agent available by writing direct.

EXCELLO Friction Tape
Developed for radio service work where a narrow friction tape is essential. Machine-cut edge prevents raveling. No. 8 size package contains either 2 rolls 3/8" width or 3 rolls 1/4" width tape in 60 ft. lengths. Each roll is wrapped and sealed individually in cellophane.

PANTHER AND DRAGON
friction & rubber TAPES
HAZARD
INSULATED WIRE WORKS
Division of The Okonite Co.
Wilkes-Barre, Pennsylvania • Offices in Principal Cities
4603

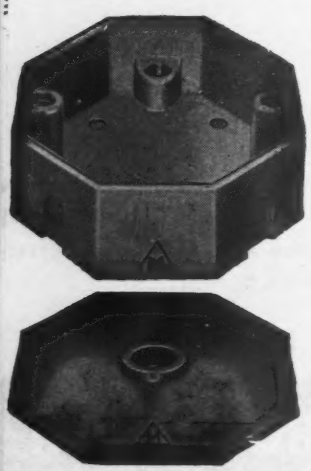
ILLINOIS
PORCELAIN WIREHOLDER INSULATORS

Insure SAFE HOUSE SERVICE CONNECTIONS..

• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.

OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws, High mechanical and electrical efficiency.

ALL-PORCELAIN ILLINOIS SYSTEMS *for outstanding, adequate and modern wiring jobs*

SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.

Bull Dog

KNOBS

Cement coated — extra length nail—genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.

STANDARD TUBES

in sizes ½ to 48 inches, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.

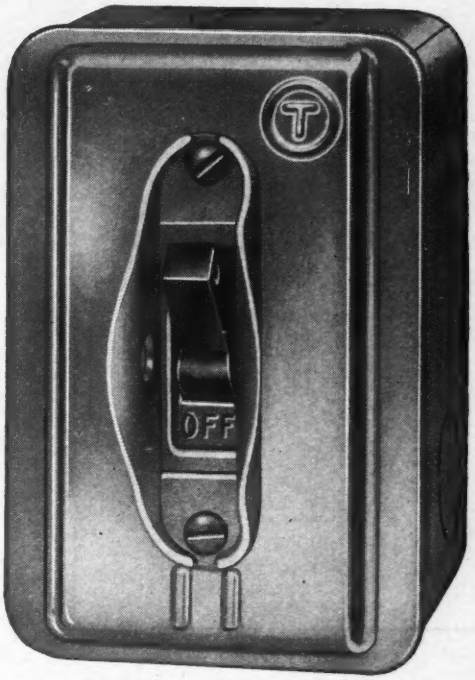
ILLINOIS ELECTRIC PORCELAIN COMPANY *Macomb, Illinois*

TRUMBULL

"T T" MANUAL STARTERS

AVAILABLE NOW FROM FACTORY STOCK

...Thermostatic Tumbler Switch...



FOR SMALL MOTOR CONTROL AND PROTECTION

COMPACT
GOOD LOOKING
INEXPENSIVE
EASY TO WIRE

Here is the ideal control and protection device for motors up to 1 h.p. wherever they are installed . . . on pumps or power tools, oil burners or air conditioning fans, office appliances, home workshop equipment or the smaller production equipment in industrial plants.

Trumbull T.T. Starters are not to be compared with ordinary small switches of cheap construction. They are quality electrical control devices that are held to the same high engineering standards as the larger Trumbull control apparatus. Equipped with interchangeable accurately calibrated heater units that "fit the starter to the motor" for positive sure overload protection. Easy to wire and readily adapted to built-in installations.

BEST OF ALL . . . these starters may be specified with assurance that they ARE AVAILABLE NOW. Write or phone for bulletin giving full specifications, dimensions, etc.

Supplied also without enclosures for "built in" mounting by machine manufacturers.

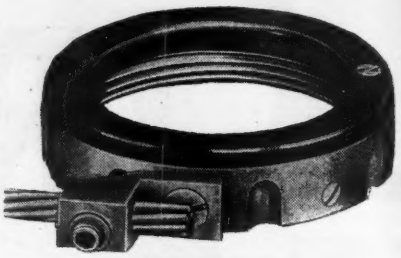
***PROTECT FRACTIONAL MOTORS . . . the* TRUMBULL "TT" WAY**

THE TRUMBULL ELECTRIC MANUFACTURING CO.
PLAINVILLE, CONNECTICUT

OTHER FACTORIES AT

NORWOOD, OHIO — LOS ANGELES — SAN FRANCISCO — SEATTLE

INSULATED BUSHINGS

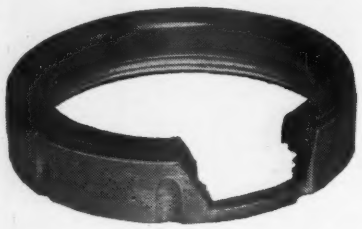


GROUNDED TYPE BL

they're OK

SET-SCREW TYPE SB

if they're O.Z.



CONDUIT TYPE B

Bakelite molded into a cadmium plated, malleable iron base—provides the O.Z. Insulated Bushing with those extra features you want.

The high insulation characteristics of the bakelite guarantees no vibration shorts, while at the same time the strength of the malleable iron base permits tightening the bushing all the way down on the conduit without stripping the bushing threads. Further, the deep metal base of the bushing insures that a Junction Box is secured and correctly grounded to the conduit without the use of an inside locknut. Last but not least, all O.Z. bushings are capped to prevent dust and water accumulation in the conduit prior to pulling cable.

With electrical wholesalers handling the complete O.Z. line, you can get O.Z. products right off your local supplier's shelves—without waiting. Call him now.

O.Z. ELECTRICAL MANUFACTURING COMPANY

262 BOND STREET · BROOKLYN 2, N. Y.

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • SOLDERLESS CONNECTORS
GROUNDING DEVICES • POWER CONNECTORS

1585

All you need to know about STARTERS

Here's why...

Certified Starters are made to exacting specifications set up by foremost lighting experts to assure dependable operation and service.

Certified Starters are tested, checked and CERTIFIED as to compliance with these specifications by impartial experts, Electrical Testing Laboratories, Inc.

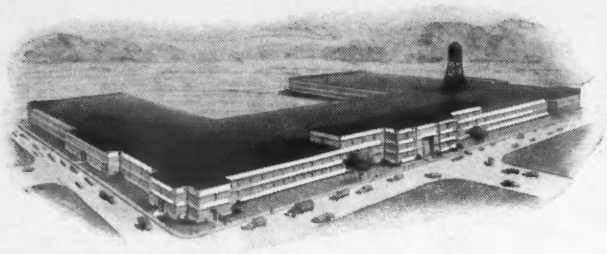
And Certified Starters are regularly rechecked at factories—under actual operating conditions—to assure you of continued high quality manufacture. Giver your customers longer lamp life—better lighting service from fixtures—with CERTIFIED STARTERS.

Certified Starters are specified equipment of FLEUR-O-LIER and RLM fluorescent lighting fixtures.

The Manufacturers of

Certified Starters

The Arrow-Hart and Hegeman Co., Hartford, Connecticut
The Bryant Electric Co., Bridgeport, Connecticut
Dura Electric Lamp Co., Newark, N. J.
General Electric Co., Bridgeport, Connecticut
Harvey Hubbell, Inc., Bridgeport, Connecticut
Instant Glow Starter Corporation, New York, N. Y.
Kuthe Laboratories, Inc., Newark 4, N. J.
The Lloyd Products Co., Providence, R. I.
Pass & Seymour Co., Syracuse, N. Y.
Sheldon Electric Co., Irvington, N. J.



FOR INDUSTRIAL WIRING

The Modern Way is

Note the number of tubes one man lifts easily. Because ELECTRUNITE E. M. T. (Electrical Metallic Tubing) is threadless—requiring no excess metal to act as a base for thread-cutting—its weight is less than half that of ordinary threaded-type conduit. Hence it is easier to handle . . . helps to take the "arm-ache" and "back-break" out of long overhead line installations.

12 Advantages

1. FULL PROTECTION
2. NO THREAD-CUTTING
3. INCH-MARKING
4. LIGHT WEIGHT
5. EASY TO BEND AND REBEND
6. STANDARD FITTINGS
7. EASY TO INSTALL
8. UNBROKEN CORROSION-RESISTANCE
9. KNURLED INSIDE SURFACE
10. UNIVERSAL ACCEPTANCE
11. LOW COST
12. WIDESPREAD DISTRIBUTION

the Electrunite Way

ELECTRUNITE E. M. T.—THE *ORIGINAL* LIGHTWEIGHT RIGID STEEL RACEWAY—SIMPLIFIES INSTALLATION PROBLEMS, SAVES TIME AND WORK ON EVERY JOB

Just as modern industrial plants need modern electric wiring circuits, so, too, do they need dependable, modern protection for those circuits . . . protection in the form of Republic ELECTRUNITE E. M. T.—the streamlined wiring raceway.

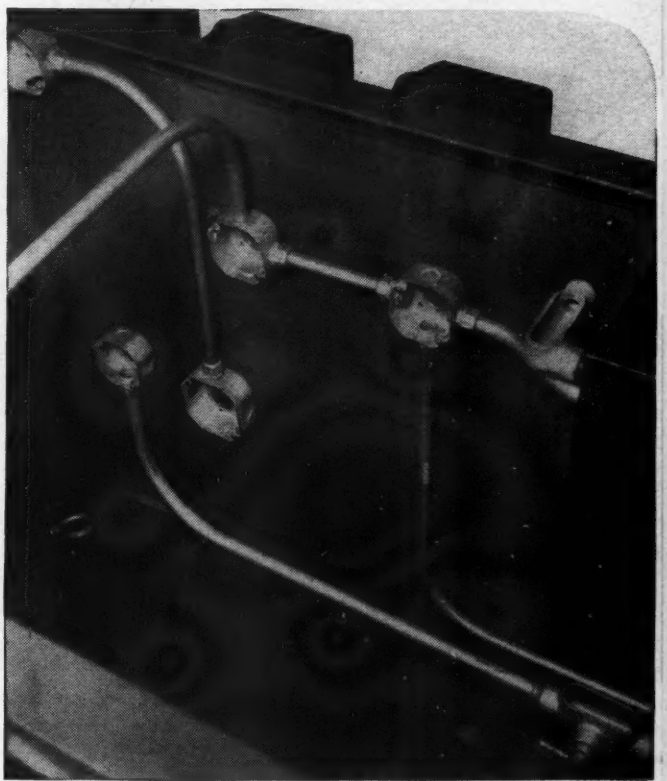
With threadless ELECTRUNITE E. M. T., dirty, tedious thread-cutting is a thing of the past . . . replaced by up-to-date, simple compression-type fittings. Quickly tightened with wrenches or pliers, these fittings create strong, water-tight joints which will not work loose under vibration.

Weighing less than half as much as ordinary threaded-type conduit, ELECTRUNITE E. M. T. is easier to bend, and easier to handle—especially in cramped, hard-to-reach locations.

Yet, because it is made from tough, cold-rolled steel, ELECTRUNITE E. M. T. meets Underwriters' Laboratories requirements for adequate mechanical and electrical protection . . . and is approved by The National Electrical Code for exposed, concealed and concrete slab construction.

That's only part of the story. For complete details about the many advantages of *modern* ELECTRUNITE E. M. T., see your nearest ELECTRUNITE Distributor, or write to:

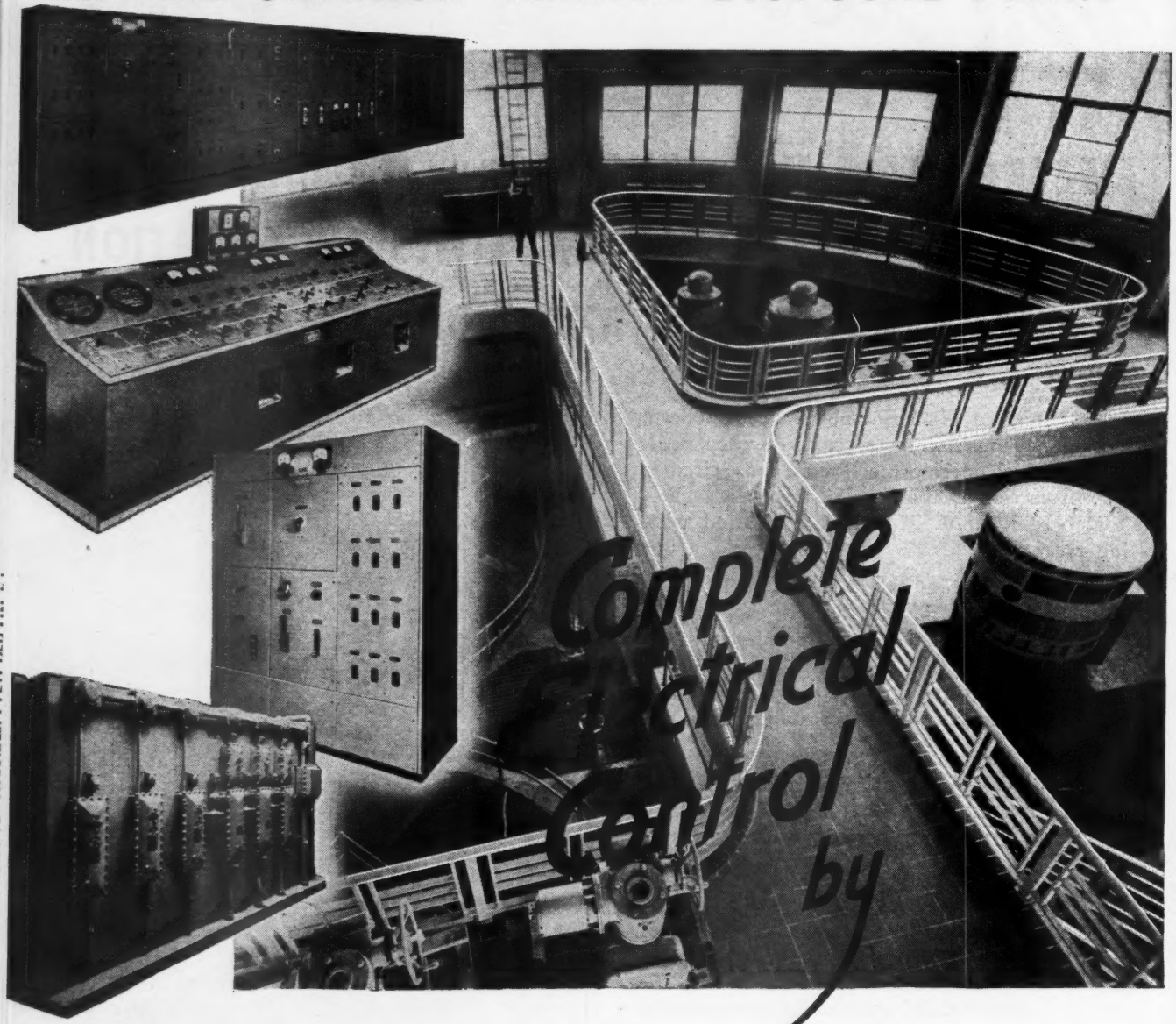
REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



Wiring can be replaced, revised or changed quickly and at extremely low cost with a "pull-in—pull-out" raceway system made of safe, dependable Republic ELECTRUNITE E.M.T.

Republic
ELECTRUNITE E.M.T.
REG. U. S. PAT. OFF.
LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY

FOUR of the 18 METROPOLITAN SWITCHBOARDS IN THE JAMAICA SEWAGE DISPOSAL PLANT



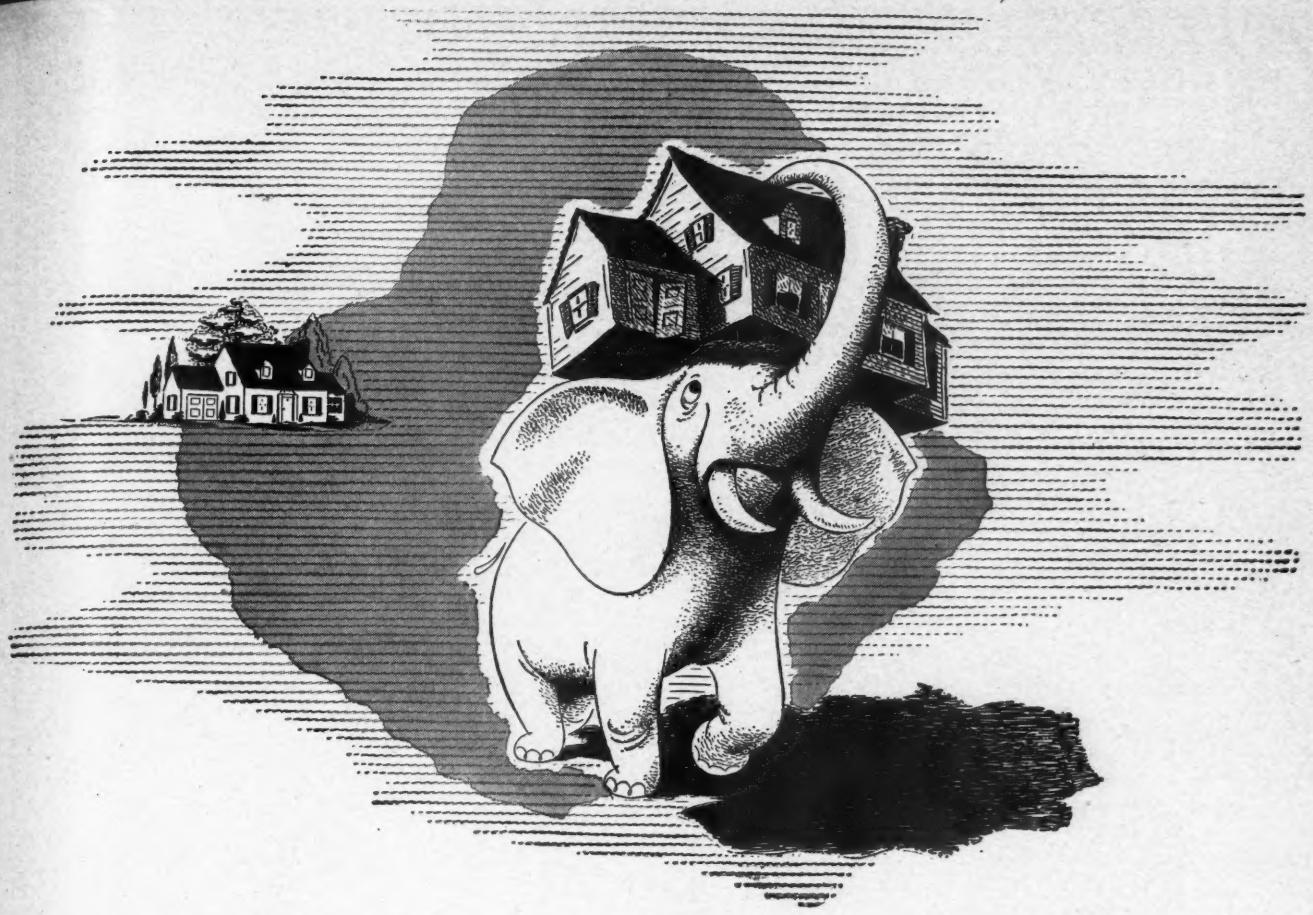
At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

Knife Switchboards
Circuit Breaker Switchboards
Dead Front Switchboards
Battery Charging Switchboards
Motor Control Switchboards
Explosion-proof Switchboards
Laboratory and Test Switchboards
Control Switchboards
Generator and Distribution Switchboards

ESTABLISHED 1892 METROPOLITAN TRADE MARK

ELECTRIC MANUFACTURING COMPANY

ELECTRIC LIGHTING AND POWER
DISTRIBUTION EQUIPMENT
LONG ISLAND CITY 5, NEW YORK



white colonial, 1946 white elephant, 1956

don't let today's dream home become tomorrow's disappointment . . .

because of inadequate wiring

Right now, your job as an electrical contractor bears an important new responsibility. With costs of new homes limited, it's up to you to keep a "skimpy" electrical system from limiting their livability and future value. At the same time, you'll be protecting your own income and future reputation.

Today, a small, unpretentious house requires more *thorough electrical planning* than any house of the same type ever required before. It will be bought and occupied by people who are counting on *electrical conveniences* to make up what they lack in space and elaborate architecture. They'll want plenty of outlets, wired to handle everything from toasters to television. They'll want lighting to make small rooms look spacious.

By working with local builders and architects now, you can verify the fact which General Electric has already emphasized: *that adequate wiring adds more value per dollar to a home than any alternative use of the same few extra dollars.*

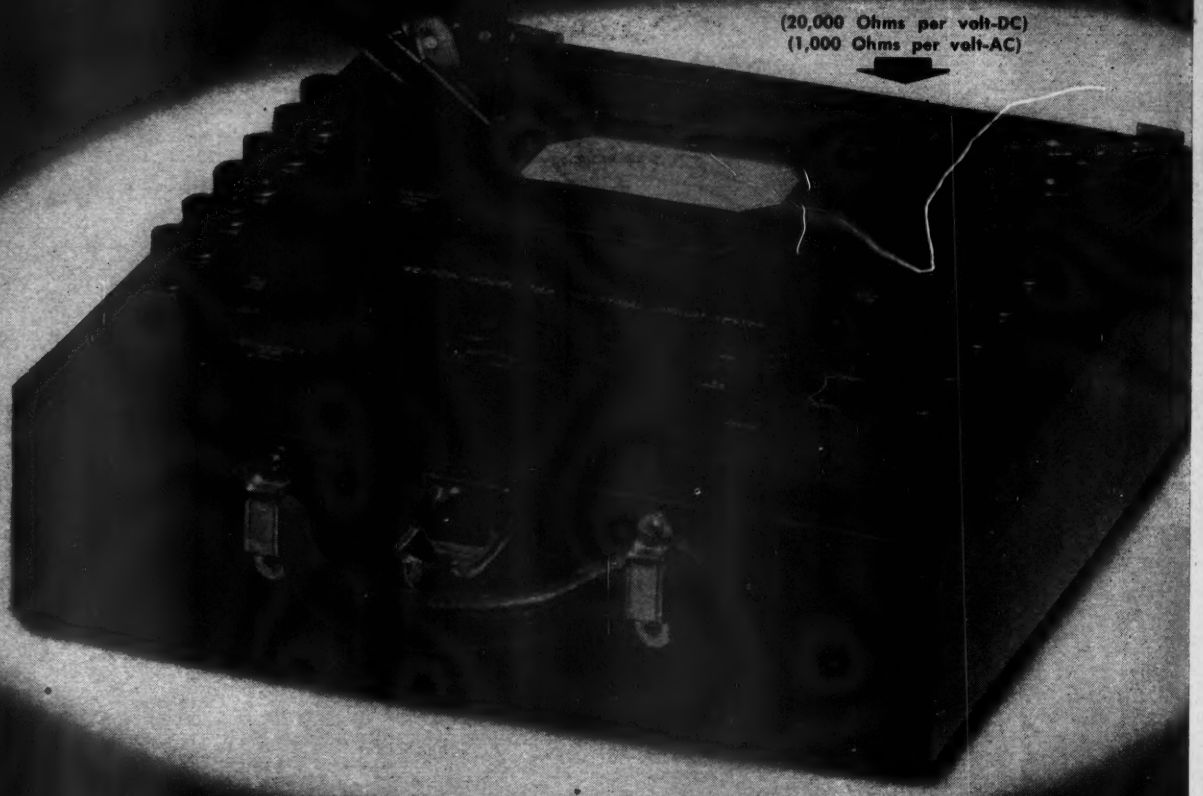
To aid you, G.E. has prepared hard-hitting booklets for homebuilders. You can use them to stave off electrical "skimping" . . . to sell the combination of *better wiring materials* and a better wiring job. Just write for *Adequate Wiring Help* to Section AW1-8-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

The Compact Instrument of Broad Utility

WESTON (MODEL 785) INDUSTRIAL CIRCUIT TESTER

(20,000 Ohms per volt-DC)
(1,000 Ohms per volt-AC)



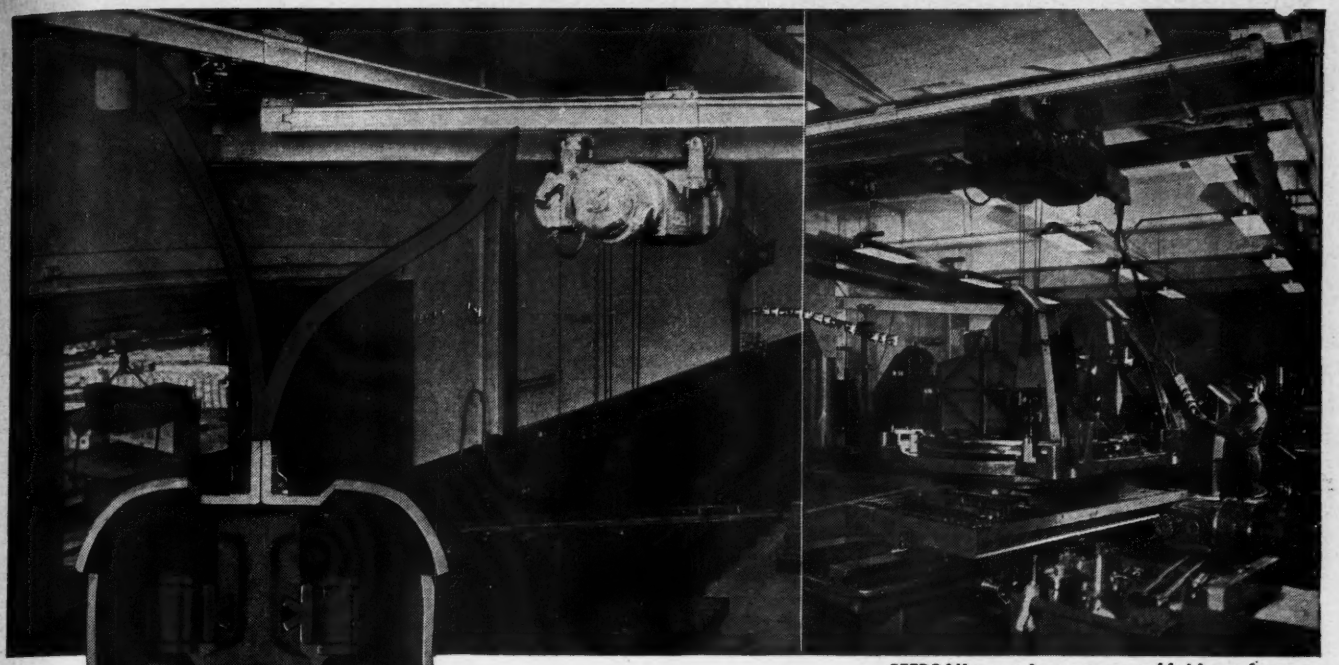
Provides 27 carefully selected AC and DC voltage, current and resistance ranges on long legible scales. A versatile instrument for servicing, plant maintenance or laboratory needs . . . rugged and moderately priced. Details from your local WESTON representative, or direct from . . .

- for measurements in: Electronic . . . Communication . . . Sensitive Relay . . . Aircraft . . . Lighting . . . Motor . . . and Industrial Control Circuits.
- Convenient Accessories: Weston Socket Selectors, Model 666. Weston Televerter for 5,000 or 10,000 Volts DC, Model 766.

Weston *Instruments*

Weston Electrical Instrument Corp., 672 Frelinghuysen Ave., Newark 5, New Jersey.

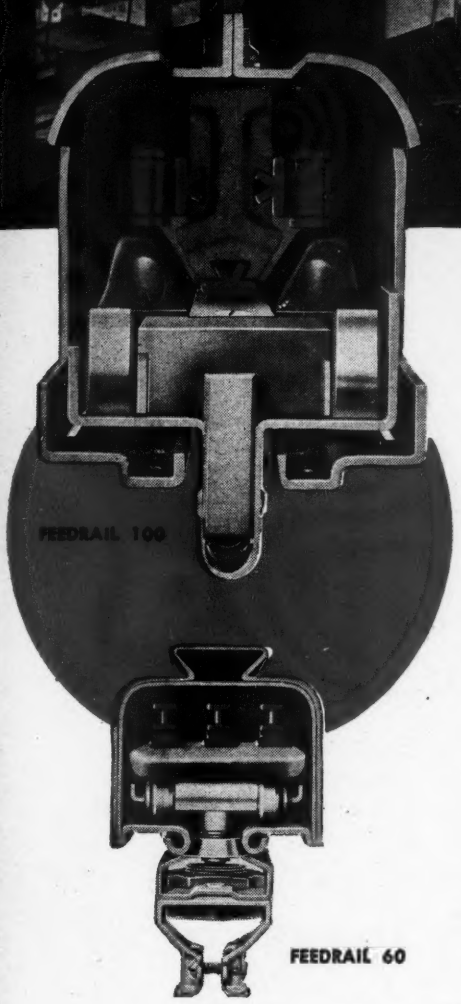
Albany·Atlanta·Boston·Buffalo·Chicago·Cincinnati·Cleveland·Dallas·Denver·Detroit·Jacksonville·Knoxville·Los Angeles·Meriden·Minneapolis·Newark·New Orleans·New York·Philadelphia·Phoenix·Pittsburgh·Rochester·San Francisco·Seattle·St. Louis·Syracuse·In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.



FEEDRAIL on main runways and bridges of cranes

MODERNIZE

YOUR CRANES AND HOISTS WITH FEEDRAIL



Exposed trolley wires have no place in a modern plant. In a day's time, you can substitute the enclosed ELECTRIC FEEDRAIL System.

It requires little space, and is furnished in assembled units in stock lengths and curves. Also available for transfers and switches to fit any desired layout.

Feedrail is mechanically strong, electrically foolproof. Trolleys are completely polarized. All electrical parts enclosed, protected against dust — accidental shorts — mechanical injuries.

AND HIGH CYCLE TOOLS

Feedrail is also designed especially for high cycle and portable tools and is used extensively for moving test racks.

Ask for

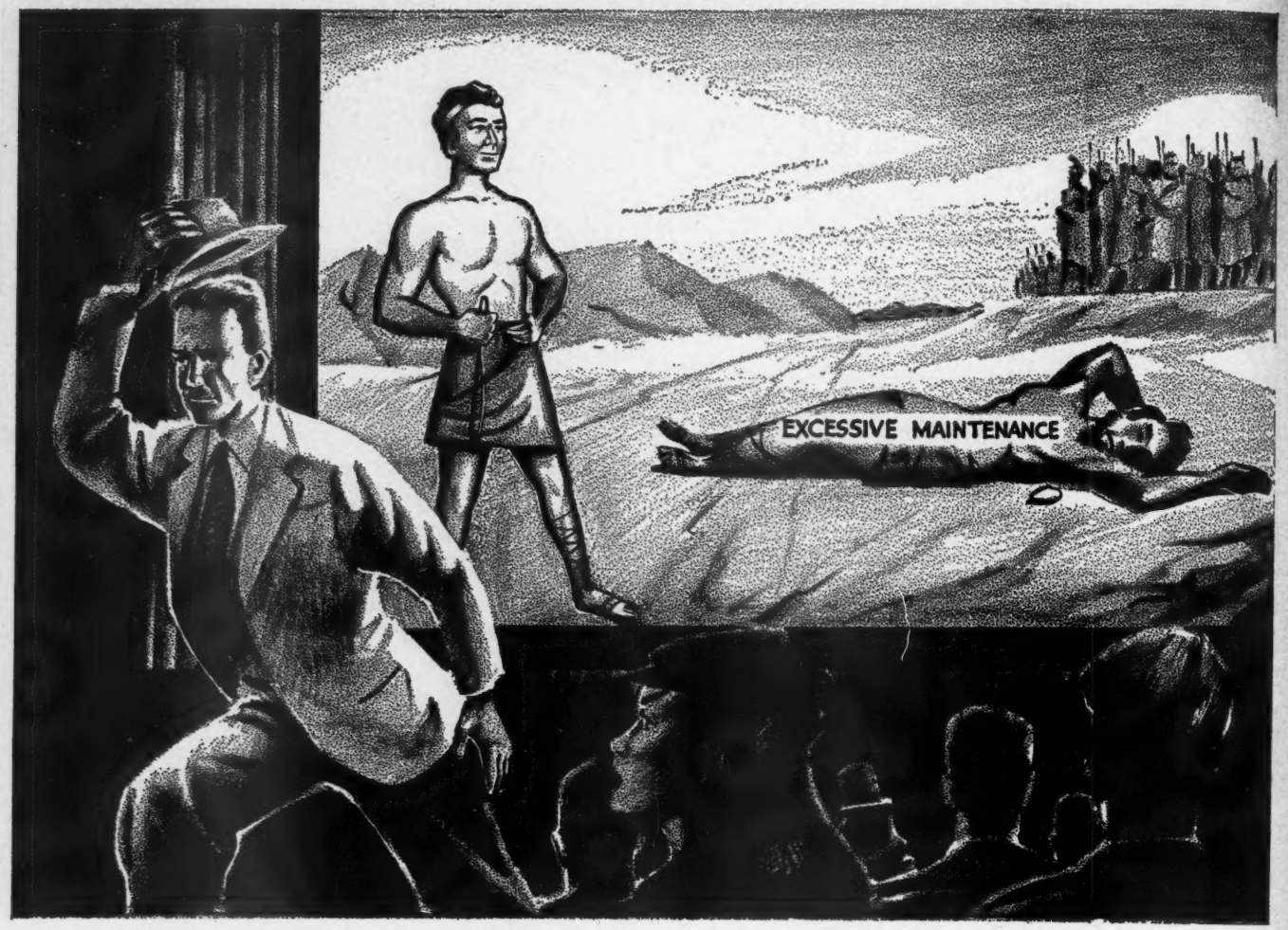
ELECTRIC FEEDRAIL
CATALOGS GENERAL No. 15
NEEDLE TRADES No. 16
MACHINE TOOL No. 17

ELECTRIC FEEDRAIL

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company

125 BARCLAY STREET NEW YORK 7, N. Y.



INSTA-START Knocks Out Excessive Maintenance Before It Gets Going

Scores of millions of dollars soon will be invested in hot cathode fluorescent, by chain and independent merchants, if the fluorescent lighting industry faces the fact that Excessive Maintenance can be and must be eliminated.

In commercial lighting the demand is for the simplest, safest, most dependable equipment — today this is supplied by instant starting hot cathode lamps operating at conventional voltages in fixtures equipped with INSTA-START Transformers.

INSTA-START Transformers perform both the ballast and the starter function in one unit, doing away with the separate starter, and reducing maintenance to cleaning and relamping.

Since 1941, hundreds of thousands of INSTA-STARTS have provided instant starting, stabilized lighting performance and low maintenance cost all over the United States and Canada.

FRANCE
INSTA-START
TRADE MARK
The Keystone of Fluorescent Lighting

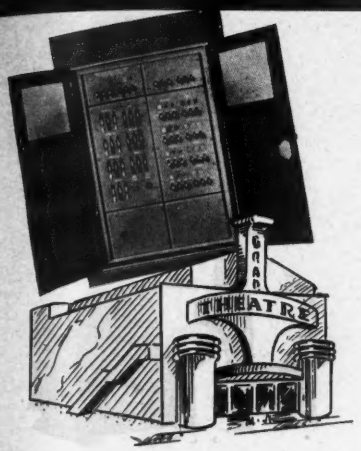
Write for latest circular and prices on INSTA-START Transformer

THE FRANCE MANUFACTURING COMPANY

Manufacturers of INSTA-START Fluorescent Transformers and Franceformers for Neon Signs

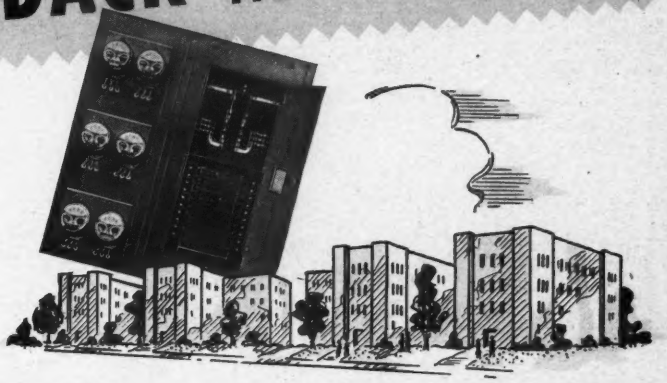
10325 BEREA ROAD • CLEVELAND 2, OHIO

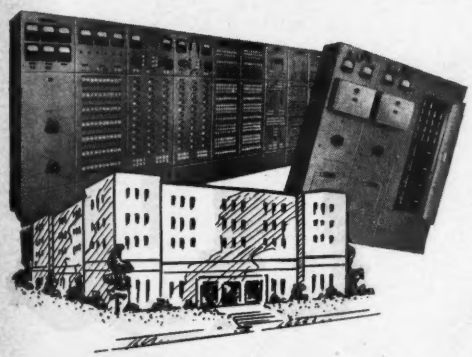
In Canada: Allanson Armature Mfg. Co., Ltd., 21 McCaul St. Toronto 28



CUSTOM-BUILT TO FIT EACH SPECIFIC JOB...

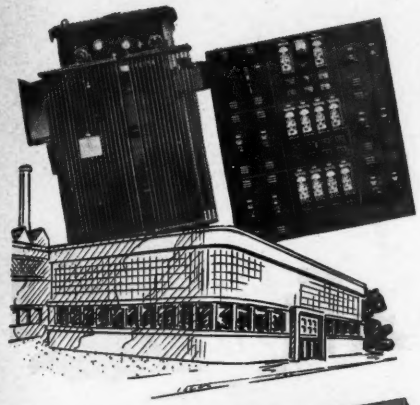
WURDACK SWITCHBOARDS and PANELBOARDS





Compact and flexible for modern requirements

Accessible for simplicity of installation...



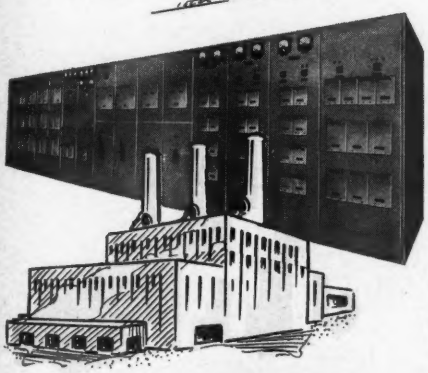
For theatres and auditoriums—STAGE LIGHTING PILOT BOARDS.

For schools and universities—EXPERIMENTAL LABORATORY CONTROL EQUIPMENT.

For housing projects and office buildings—METER CONTROL PANELBOARDS.

For industrial plants—LOAD CENTER, MOTOR CONTROL and COLUMN-TYPE PANELBOARDS and BUS DUCT.

For power plants and municipal buildings—MAIN SERVICE and DISTRIBUTION SWITCHBOARDS and PANELBOARDS.



The complex power demands of modern buildings call for compact, accessible power control equipment. The most complicated installations are simplified by the custom-built construction of Wurdack switchboards and panelboards. Wurdack ease-of-installation design eliminates many time-consuming "tailoring" operations on the job.

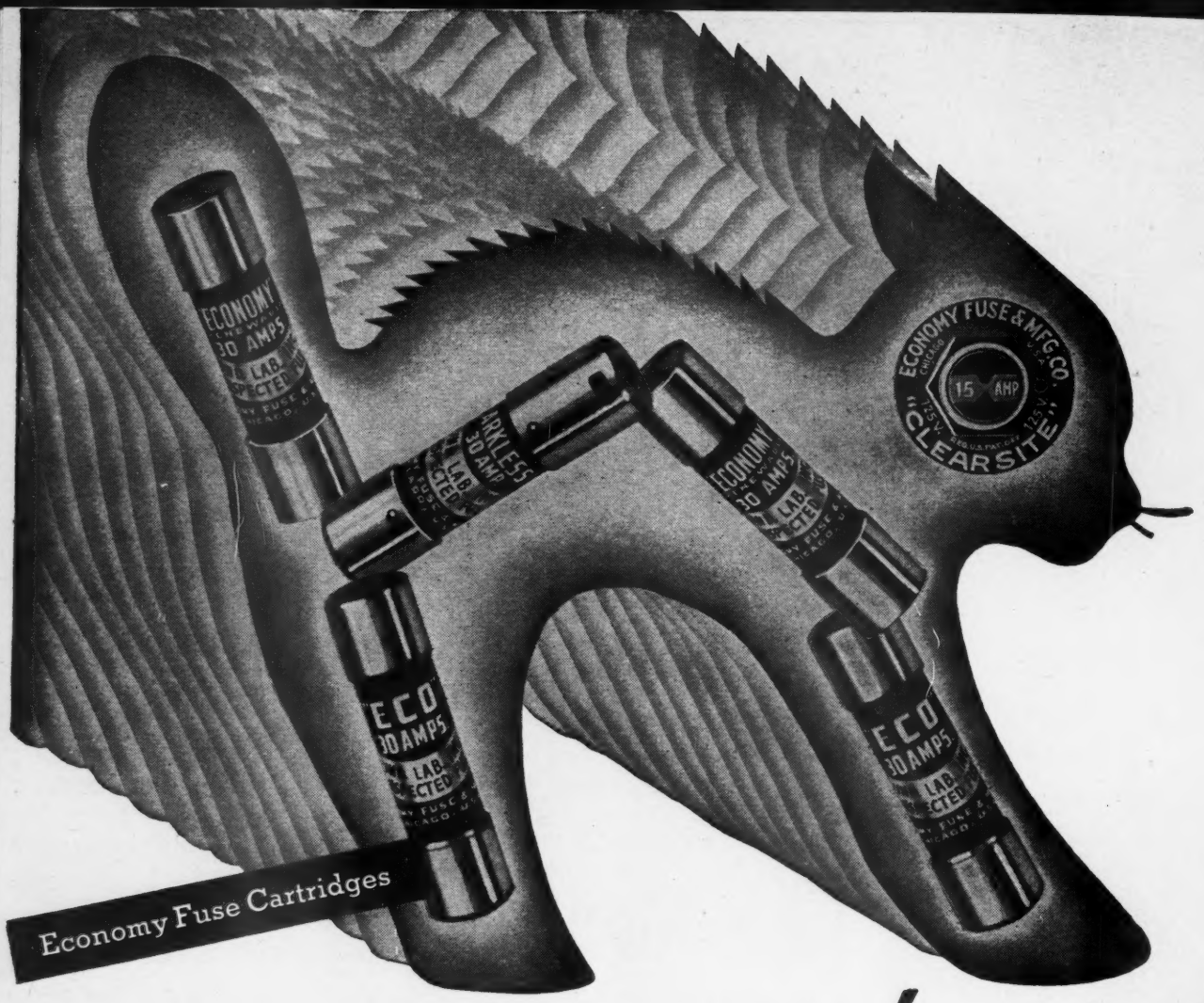
The flexibility of Wurdack switchboards and panelboards provides for future circuit changes and increased load expansion without extensive "teardowns," complete rewiring and costly service interruptions.

Front removable sections and standardized panel combinations are only a few of the Wurdack flexibility and accessibility features.

Send for Wurdack Catalogs with illustrations, data and price lists

WM. WURDACK ELECTRIC MFG. CO.

4444 CLAYTON AVENUE SAINT LOUIS 10, MO.



MANY TIMES MORE THAN *Nine Lives!*

Over and *over* and *over* again you can use Economy Fuses with Economy "Drop Out" Renewal Links.

Each Economy Cartridge Fuse is designed to last indefinitely... a tough molded body of high grade vulcanized fibre tubing, with extra heavy brass inserts and caps, accurately machined... built to give service and prevent needless and costly current interruptions.

Economy "Drop Out" Renewal Links are inexpensive... give *full limit* protection... are easily and quickly replaced to restore a blown fuse to its original efficiency.

Economy pioneered and developed the use of renewable fuses. It has constantly improved the quality, performance and dependability of Economy Fuses and "Drop Out" Renewal Links.

Protection with ECONOMY

Cartridge Type

0-600 Amps 250 Volts
0-600 Amps 600 Volts

Plug Type

3-30 Amps 125 Volts

Protection WITH ECONOMY

TIME-TESTED • RELIABLE • SAFE

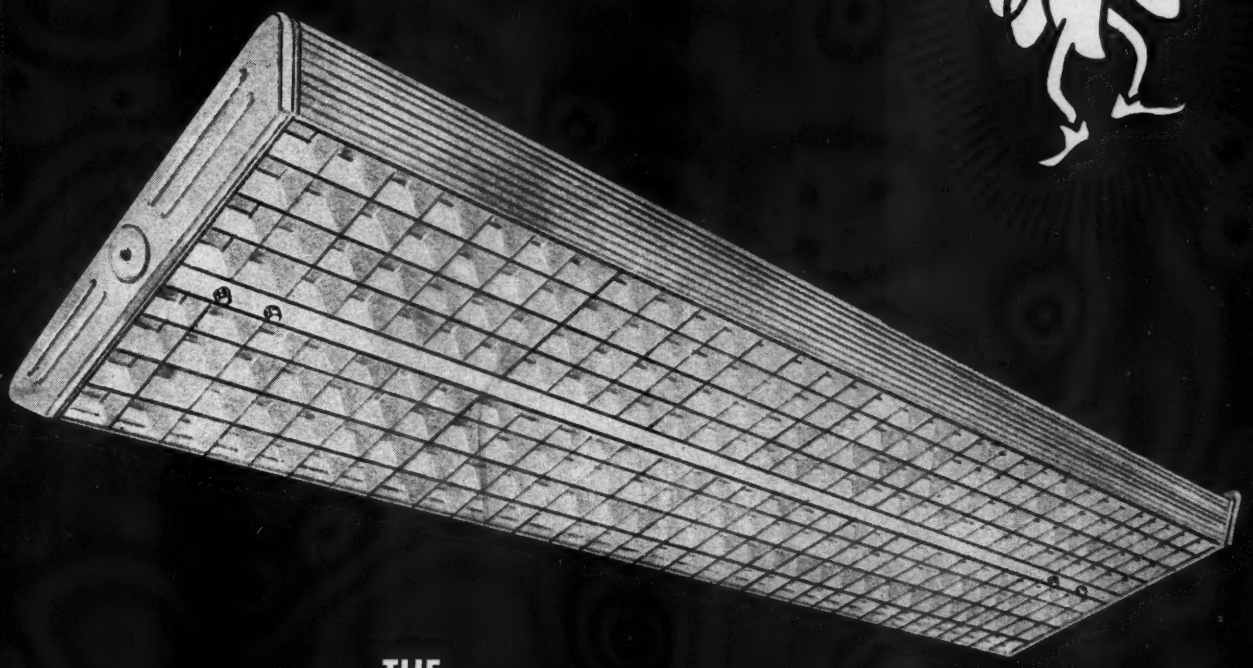
Representatives in all principal cities... SOLD THROUGH JOBBERS EXCLUSIVELY SINCE 1911. First to be approved by Underwriters' Laboratories.

1039

ECONOMY Fuse and Mfg Co.

2717 Greenview Ave., Chicago 14, Illinois

FREDDIE FIREFLY PRESENTS



THE

SUPER HI-LITE*

The ultimate in simplicity,
beauty and efficiency.

* DISTRIBUTED ONLY THRU ELECTRICAL WHOLESALERS

KAHN MFG. CO. INC.

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Finishing touch in Kitchen Planning

Aeropel—new *profit opportunity* for you!

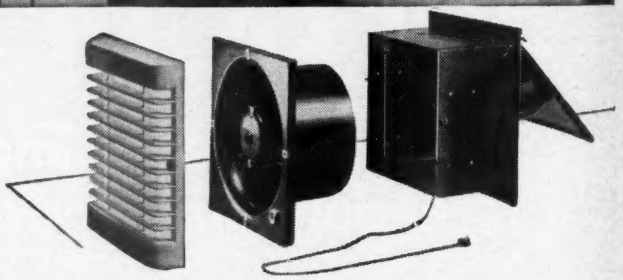
A KITCHEN fresh as a daisy—cool, clean and comfortable—that's every housewife's dream. And it's a profit opportunity for any dealer handling the new Aeropel Home Ventilator.

Aeropel is designed for quick, profitable installation in any kitchen, old or new. The unit fits neatly—as though architect-planned.

A pull of the bead chain—and this efficient, super-quiet ventilator goes to work. Cooking odors, greasy fumes and smoke disappear. Built by American Blower and *priced for competitive selling!*—capacity ratings certified and guaranteed.

Aeropel sales possibilities include bedrooms, nurseries, bathrooms, laundry, recreation and utility rooms. Ample capacity also for most offices, reception, conference and rest rooms.

Ask your jobber or call the nearest American Blower Branch Office for complete information on Aeropel—the best answer to the demand for *kitchens fresh as a daisy.*



Above view shows: White plastic grille—Tubeaxial 3 bladed aerocurve propeller type fan driven by totally enclosed, constant speed 115 volts 60/50 cycle single phase motor—fabricated steel wall box, bonderized for rust protection—new exclusive weather door with automatic latching mechanism.

AMERICAN BLOWER

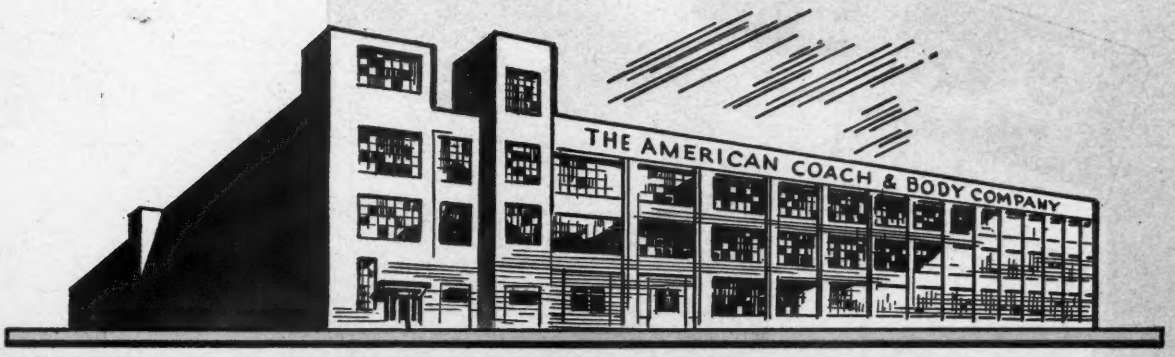
Aeropel

Home Ventilator

AMERICAN BLOWER CORPORATION

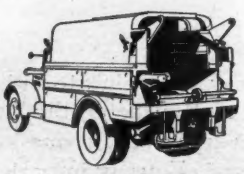
Detroit 32, Michigan

Division of American Radiator & Standard Sanitary Corporation



BETTER EQUIPMENT MAKES POSSIBLE BETTER STANDARDS of PUBLIC SERVICE

American's renowned "storeroom on wheels!" has many standard features . . . Ask for the new bulletin, just off the press, on American's Line Construction Bodies . . . shows dimensions, sizes, equipment, features, and other useful data.



Another example of standardization . . . by incorporating crew compartment in body, American removes cab from the "special" to the standard class, offering ready resale on open market. Ask for new bulletin on the American B-4.

AFTER WORLD WAR I, America showed the world how mass production could lower the price of goods . . . place them within reach of millions and create a higher economic standard of living than any other people ever achieved.

This time, industry foresees another opportunity to progress still further in the development of high production at lower costs . . . *through the intelligent application of efficient standardization.*

In the utility field, American Coach translates standardization as a means of reducing distribution costs while improving the already high standards of service to the public. This company, as the largest manufacturer of utility bodies, will aid utilities to achieve the objectives by continuing to design and build standard "special" bodies.

Standardization is not new with us. American bodies are made of standard parts to permit easy maintenance and assembly line production. Gadgets and trick features purposely have been left out. To put "special bodies" in the standard class, as we have done, requires ample resources of facilities, personnel, engineering, and experience. *We have them.*

Equally important, many of our features have been developed and adopted at the suggestion and recommendation of the operators as a result of field experience in using this equipment.

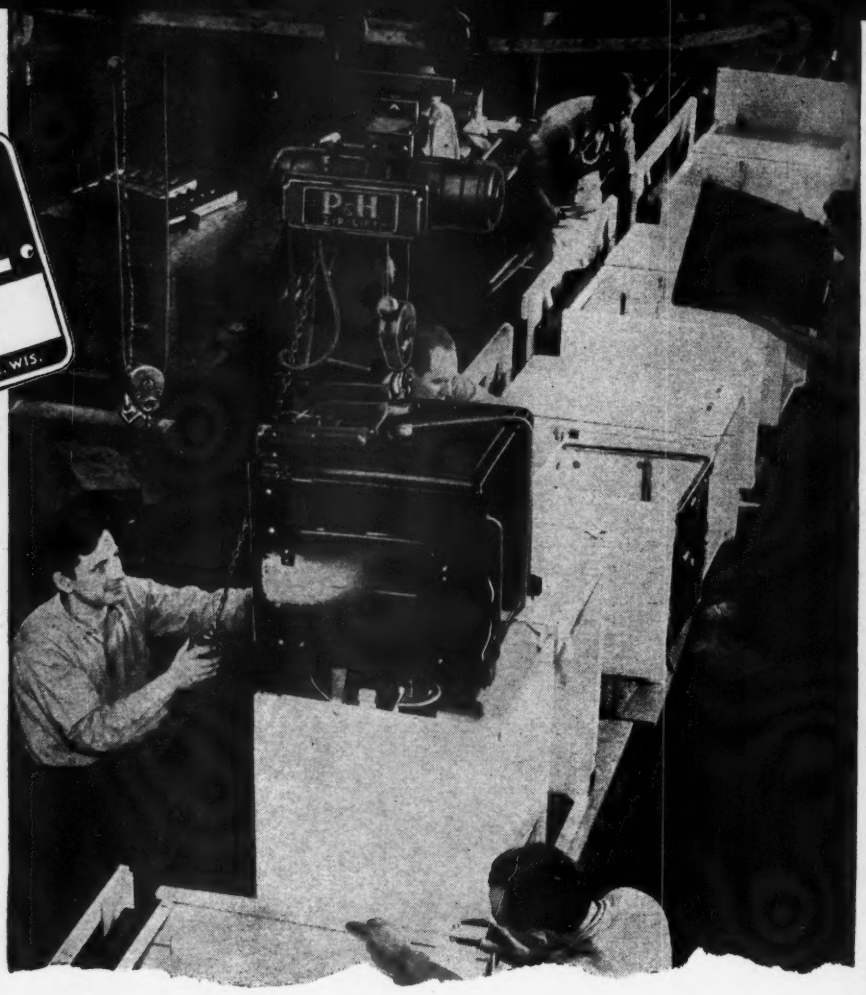
THE *American* COACH and BODY COMPANY

9503 WOODLAND AVE., CLEVELAND 4, OHIO

"Baker American", Baker Equipment Engineering Co., Richmond, Va., Sales and Assembly

ACB and

P&H ZIP-LIFT
HARNISCHFEGER CORP. MILWAUKEE, WIS.



ON ASSEMBLY LINES, TOO!

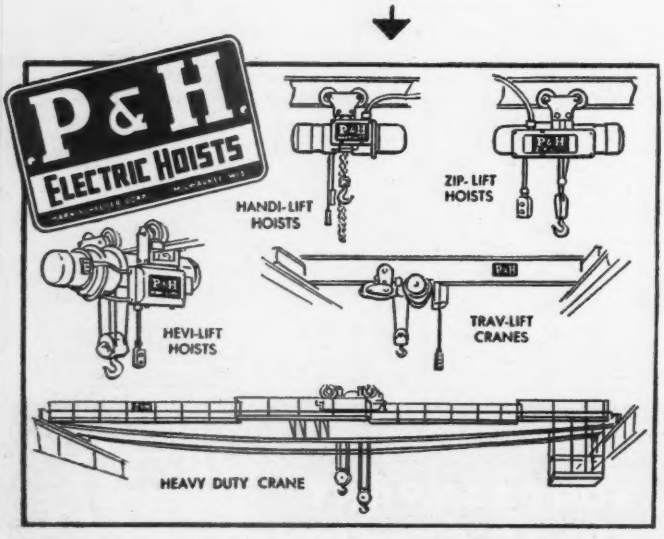
COST-SAVER

"THRU-THE-AIR" handling speeds production —

Here's a case of one back-saver helping to build another . . . a P&H Zip-Lift Hoist placing the "inners" in electric dishwashers. It's an assembly line operation—so *speed* is a must. Equally important is the gentle, *precision* "spotting" of the load.

Jobs of this kind are made to order for Zip-Lifts. Traveling "thru-the-air" they move direct—over assembly lines—leaving all floor space for production. Smooth electric power makes it *easy* . . . push buttons provide *accurate control* . . . an unbeatable combination for the production line.

But P&H Zip-Lifts are far more than an assembly line aid. "Thru-the-air" handling speeds the flow of materials throughout the plant—from raw to finished state! A P&H Hoist Engineer will gladly demonstrate. Call him in . . . or write for free Zip-Lift Bulletin!



HARNISCHFEGER CORPORATION
HOISTS • WELDING ELECTRODES • MOTORS P&H EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

General Offices: 4426 W. National Ave., Milwaukee 14, Wis.

SPECIAL PURPOSE OUTLETS

THESE Outlets serve special purposes *in addition* to those served by ordinary receptacle types. Their *extra*-utility has durable basis in right design, rugged parts, reliable workmanship.

No. 7707,—Clock Hanger Outlet: Provides electrical connection and mechanical support for clock. No. 7792,—Weatherproof Receptacle with cadmium-finished brass plate, metal cap and weather-tight rubber mat. No. 7797,—Floor Outlet, with 2 threaded brass covers; one to shield plug cap and one to close outlet when not in use. No. 7750,—Fan Hanger Outlet: Provides mechanical support for fan, with electrical connection. No. 1914,— Duplex 2-circuit Receptacle; one circuit always "ON" for appliances, the other to be switch-controlled as for lamp circuit.

Ask for complete catalog listings of the types here shown as representative, as well as standard outlets and switches.

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

To help you in designing or installing modern LIGHTING SYSTEMS

. . . 80 of the 400 manufacturers with catalog data in the 1946 E-B-R give buying information on lighting fixtures, equipment and accessories.

Accurate Insulated Wire Corp.
Adalet Mfg.
Alden Products Co.
Appleton Electric Co.
Austin Co., M. B.
Bead Chain Mfg. Co.
Becker Bros. Carbon Co.
Benjamin Electric Mfg. Co.
Black Mfg. Co., M.
Bridgeport Switch Co.
Bright Light Reflector Co.
Cannon Electric Development Co.
Carpenter Mfg. Co.
Champion Lamp Works Div.
Chicago Transformer Div.
Compco Corp.
C. & P. Electric Works, Inc.
Curtis Lighting, Inc.
Day-Brite Lighting, Inc.
Dongan Electric Mfg. Co.
Drake Mfg. Co.
Electro Mfg. Co.
Electronic Laboratories, Inc.
Essex Wire Corp.
Fairbanks, Morse & Co.
Faries Mfg. Co.
Fleur-O-Lier Manufacturers
Fostoria Pressed Steel Corp.
France Mfg. Co.
Gardner Electric Mfg. Co.
General Electric Co.
General Insulated Wire Works, Inc.
Herwig Co.
Holdenline, Inc.
Ideal Commutator Dresser Co.
Jackson Electrical Co.
Jefferson Electric Co.
Joleco Corp.
Joslyn Mfg. & Supply Co.
Kahn Mfg. Co.
Kato Engineering Co.
Kellogg Switchboard & Supply Co.
Keystone Electric Mfg. Co.
Killark Electric Mfg. Co.
Kwikon Co.
Leader Electric Mfg. Corp.
Lighting Products, Inc.
McGill Mfg. Co.
Mitchell Mfg. Co.
National Carbon Co.
Newart Mfg. Co.
Onan & Sons, D. W.
Overbagh & Ayres Mfg. Co.
Philadelphia Electrical & Mfg. Co.
Pyle-National Co.
Quadrangle Mfg. Co.
Revere Electric Mfg. Co.
Russell & Stoll Co.
Simplet Electric Co.
S & M Lamp Co.
Sola Electric Co.
Solar Electric Corp.
South Bend Current Controller Co.
Spero Electric Corp.
Stackpole Carbon Co.
Steel City Electric Co.
Sylvania Electric Products, Inc.
Thompson Electric Co.
Tobe Deutschmann Corp.
Trumbull Electric Mfg. Co.
United Transformer Corp.
Universal Clay Products Co.
Verd-A-Ray Corp.
Ward Leonard Electric Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheeler Reflector Co.
Wm. Penn Fluorscent Light Mfrs.
Wood Specialty Mfg. Co.
Wurdack Electric Mfg. Co.

E-B-R has been sent you to help in your problems of product comparison and selection.

E-B-R gives you in one place, instantly accessible catalog information making it easy to compare and select from among products of hundreds of manufacturers.

609 pages of manufacturers' catalog information . . .

a directory section of unrivaled completeness, giving the names and addresses of all known manufacturers of thousands of electrical products. . . . . .

. . . make E-B-R the most complete reference of product information in the electrical field.

E-B-R is distributed each year immediately upon publication, under contract with the manufacturers whose product data is contained therein, to the key men in certain specific industry classifications.

Catalog & Directory Division

McGraw-Hill Publishing Co., Inc.

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Chelsea Ventilating Coolers for Home, Office, Factory or Store!

MEMBER PROPELLER FAN MANUFACTURERS ASSOCIATION

PLAN NOW

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fford quiet,
with max-
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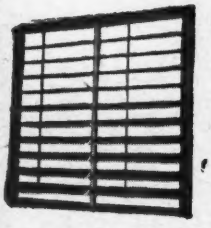
blowers
lsea for
most in

TYPE IND STREAMLINED INDUSTRIAL FAN:

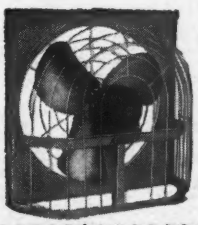
TYPE ED STREAMLINED ATTIC FAN:

rolled-
y under static
ced blades of heavy
totally enclosed ball-
Moving parts are rubber

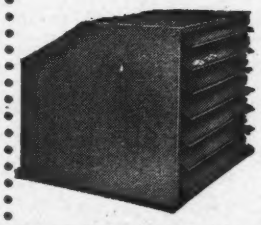
INVESTIGATE THESE WIDELY-USED CHELSEA VENTILATING UNITS



Type LWL Automatic Louvers: For general ventilation installations. Protects fan when not in use. Aluminum leaves pivoted in machined brass to reduce friction; tie rods cadmium plated bushings. Larger units dual to eliminate twisting of leaves.

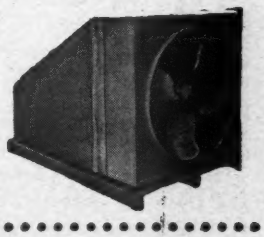


Type AA Utility Fan: For cold storage, meat packer and freezer applications. Totally enclosed ball bearing motor with both front and rear guards. Capacity: AA20 — 3000 CFM; type AA24—4800 CFM. Fan speed—1100 rpm.



Type PH Penthouse Roof Ventilator: For roof ventilation. Operates against static pressures using the IND type industrial fan housed in steel penthouse with automatic shutters. Completely assembled—ready for installation

Type P and MC Pedestal Fans: For shops, offices, stores, and factories. Rugged construction with steel die-stamped blades. Motor and fan shaft ball bearings. All parts protected against rust. Available in a wide range of sizes.



Type EU Package Attic Fan Unit: For cooling homes, churches, hotels, hospitals, schools, etc. New streamlined venturi orifice delivers greater air volume. ASH and VE method certified ratings. Efficient, low current consumption motors.

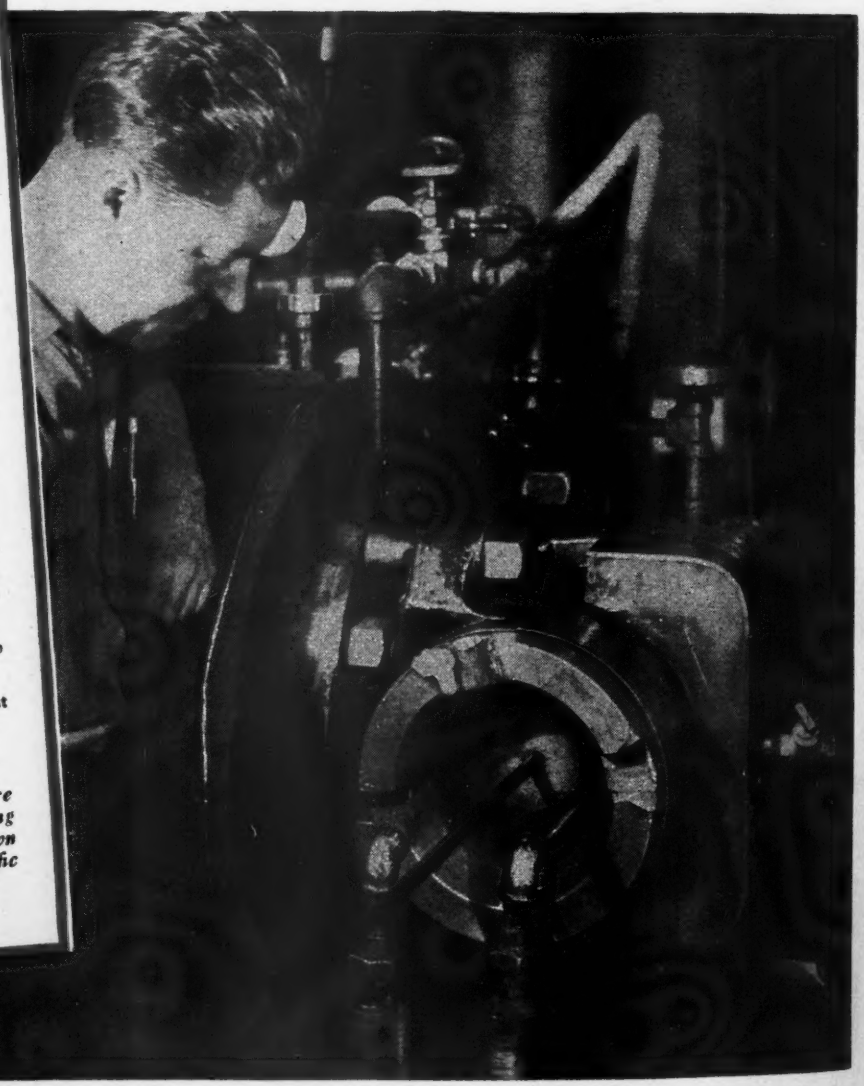
CHELSEA **CHELSEA PRODUCTS**

1206 GROVE STREET, IRVINGTON, NEW JERSEY

CHIEF ADVANTAGES OF AMPYROL

1. **High dielectric strength**—Permits use of thinner walls for low voltage applications.
2. **Increased conduit capacity**—Larger capacity wires or a greater number of wires can be carried in a conduit of given diameter.
3. **Chemically inert**—Unaffected by moisture, acids, or alkalis.
4. **Oil resistant**—Can be immersed in oil or grease for long periods of time without damage.
5. **Ozoneresistant**—Unharmed after months of exposure to ozone that would destroy ordinary rubber insulated wires in a matter of minutes.
6. **Flameproof**—Does not burn, support combustion, or carry flame.
7. **Unaffected by sunlight.**
8. **Flexible**—Can be bent at sharp angles without damage, and is tough enough to require no protective covering for ordinary applications.
9. **Aging qualities**—Excellent due to chemical inertness.
10. **Free stripping**—Strips easily and cleanly from conductor.
11. **Easy to work**—Splices easily and is adaptable to any kind of tape. No special techniques required.
12. **Surface**—Smooth, lustrous, easy to keep clean.
13. **Colors**—Available in 12 brilliant colors that do not wear off. Makes identification easy.

Large and small *U·S·S Ampyrol Wire and Cables are available. The milling and mixing of plastics is under our own control and can be varied to meet specific customer needs.*



Synthetic Resin Insulation

LOW VOLTAGE WIRE AND CABLE

OIL doesn't rot it.

WATER doesn't penetrate it.

CHEMICALS don't damage it.

FLAME doesn't burn it.

U·S·S AMPYROL is a thermoplastic resin compound that is chemically inert. It is unaffected by moisture, acids, alkalis. It has withstood complete immersion in oil and naphtha for months without deterioration. Fumes from chemical plants, ash pits, steel mills, storage batteries, etc., cause no perceptible deterioration. Ozone concentrations that would destroy rubber in short order have no effect on Ampyrol.

Fire hazards are reduced, for Ampyrol neither carries flame nor supports combustion. At recommended operating temperatures, Ampyrol is flexible yet tough and wear resistant.

Greater capacity of conduits can be obtained with Ampyrol because its high dielectric strength permits thinner insulation and greater copper area. On re-wiring jobs, it is often possible to obtain enough extra capacity to avoid ripping up the old conduit system.

The applications of Ampyrol Wires and Cables are almost unlimited. For switchboards, control apparatus, motor leads, plant wiring, railway signaling, radio sets, electronic devices, house wiring, and shipboard uses, Ampyrol is distinctly superior. Write for more complete information.

Important Applications of U·S·S Ampyrol Wires and Cables

1. Re-wiring industrial plants for higher capacity.
2. Railway signaling switchboards and control.
3. Machine tool wiring and motor leads.
4. Chemical or process plants, mines, steel mills.
5. Stores, offices, homes, public buildings.
6. Ships, locomotives, busses, automobiles.
7. Radio sets, electronic devices.

LISTEN TO . . . the "Hour of Mystery" presented by United States Steel on the radio every Sunday evening. Consult your local newspaper for time and station.

American Steel & Wire Company

Cleveland, Chicago & New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

Tennessee Coal, Iron & Railroad Company, Birmingham, *Southern Distributors*

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UNITED STATES STEEL

AMERICAN STEEL & WIRE COMPANY · USS · AMERICAN ELECTRICAL WIRE AND CABLE · UNITED STATES STEEL

U·S·S Ampyrol Wire and Cable

CURTIS

for Fluorescent Commercial Lighting

MODERN LUMINAIRES THE HERITAGE OF DECADES OF EXPERIENCE AND INTEGRITY

There's more to the design and manufacture of quality commerical lighting equipment than is apparent in a glance at the fixture or even in an inspection of figures on Light Output and Shielding Angles.

The sound principles of design and construction that make the difference between a mediocre unit, and a quality luminaire that will give years of satisfactory trouble-free usage can be learned only by long experience in designing and making lighting equipment. Curtis luminaires are the product of a concern with nearly fifty years leadership in the field.

For commercial lighting, there are no finer luminaires than the three pictured above . . . the Curtis 70610-XE . . . the SkyLux . . . and the StarLux. In these three units you have selling advantages in Beauty . . . Efficiency . . . and low maintenance cost . . . and you can tackle a wide range of jobs satisfactorily and profitably.

If you already haven't complete details and specifications on these luminaires, write today for data sheets . . . get the facts that get you business!

CURTIS Lighting INC.
6135 WEST 65th STREET
CHICAGO 38 • ILLINOIS

AUGUST. . . . *at a Glance*

Housing

Though sincere authorities on housing construction warned that the veterans' housing program was setting up impossible and visionary objectives, it begins to look as though achievement will come much closer to the "visionary" figures than anyone had thought possible. Barring strikes and other unpredicted shortages, Wyatt's goals are not only possible but will probably be accomplished as far as conventional housing is concerned. Pre-fabs, however, are still 'way behind.

Bridges

Bridges offer many possibilities for unusual illuminating methods. They are both important traffic arteries which must be well lighted for safety, and civic monuments which can be made attractive and inspiring. A unique lighting method using fixtures enclosed in the bridge handrail provides a means of raising pavement illumination intensities while reducing source glare. The method is described in "Bridge Handrail Lighting" on page 57.

Adequacy

Speed, although the very essence of the housing program, is contributing to a lot of jerry-building. Green lumber, leaky roofs, unstable foundations, and an inadequacy in plumbing, heating and electrical facilities are some of the serious liabilities that the accelerated program is incurring. The difference between minimum wiring installations and good adequate wiring is not greatly significant in the selling price of a house. It is enormously significant in its value as a place to live. A good adequate wiring job can be installed just as fast as a minimum installation. It's our job to see that the housing program gets both speed and adequacy.

Flexibility

One of the most important features of modern industrial wiring systems is the ease with which changes can be made in machinery locations as production line methods are altered and revised. At the Woodward Governor plant a network of floor sleeves provides for quick relocation of machinery. Removable plug-in fluorescent lighting fixtures and over-ceiling catwalks also permit overnight changes in lighting where necessary to revise machine grouping. Gus Eckel's story, "Wiring for Quick Change", on page 53 has all the details.

Stage Windows

We don't know what the ultimate and the optimum of window display lighting is. But it's pretty hard to imagine how the gentle art can go much farther than the fourteen theatre stages which are the show windows of John David's new store on Fifth Avenue in New York. The elaborate stage lighting methods in the window displays are well supported by modern planned lighting methods throughout the store interior. Berlon Cooper's story about this job on page 58 describes a new high in modern commercial lighting application.

Support Raceways

A well-known structural assembly long used because of its flexibility and convenience for all kinds of framework and supports has been adapted by engineers at the Caterpillar Tractor Company as a combined fixture support and conductor raceway. Not only is its use as a raceway unique in this project, but the welding techniques employed in assembling the structural members ought to stimulate a lot of new job ideas. "Supports Form Raceway" on page 62, describes the project.

Specifications

We are busy putting the final touches on a master electrical specification which will be published in the September issue. It is designed to provide a sound and substantially complete specification manual for all kinds of electrical construction and installation work. We hope it will be one of the most useful issues of this magazine ever published. We know that a similar project published ten years ago is still used and frequently consulted. Watch for this special editorial feature section in your September Electrical Contracting.

WATER, WATER EVERYWHERE

.. BUT NOT A DROP SOAKS IN!

• For economical service in machine shops, chemical plants, industrial establishments or anywhere else, use Densheath. Its synthetic compound insulation is superior to rubber in many ways: Durable • Smooth, polished finish • Pliant • Excellent superaging qualities • Good resistance to abrasion, tearing, bending, flexing • Can be used anywhere Type R is allowed • Densheath provides economical service wherever installed. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, 25 Broadway, New York 4, N. Y. Sales Offices in Principal Cities. 40321

Type T† for dry locations.
Type TW† for moist locations.
†New designations for Types SN and SNW

ANACONDA

*Reg. U. S. Pat. Off.

Densheath* TYPE T & TW BUILDING WIRE

TECHNICAL TOOLS

LOOKING OVER A CATALOG of electrical wiring materials, it is astonishing how many of them can be installed with a screw driver and pliers. Raceways, panelboards, wiring devices or fixtures, for example, can usually be installed with a simple complement of tools that contrasts incongruously with the overall skill required for safe and proper assembly and application.

THE GREAT ADVANCES in methods in recent years are largely in the direction of more power tools on the job. The pipe machine replaces hand stocks. The power hammer speeds and eases the laborious maul and drill tasks. Power cutters obsolete the hacksaw. These and like power substitutes for human muscle are good examples of job method progress. But while we move forward on this line it is important that we do not let it obscure the other areas of progress that are waiting to be explored. We have powered the mechanics tool bag. We still have to tackle the larger job of devising new tools and new techniques of fabrication in electrical construction and installation.

WELDING IS NOW A CONVENTIONAL TECHNIQUE on many large electrical installation jobs. When industrial building designers began to prohibit drilling structural members, welding afforded a means for attaching equipment to beams and columns. Out of this necessity we learned an improved technique and how to use a new tool. Today welding is frequently used to support electrical materials in industrial installations whether drilling is prohibited or not.

THERE'S A LIMIT ON WELDING TECHNIQUES, however, that is imposed by the equipment. It must eventually be attached to welded-on supports by some variation of the screw thread. Factory attached welding pads would permit aligning on clamps and permanent, secure attachment with a few passes of the rod.

THE FABRICATION OF RACEWAYS, and the attachment of boxes offer a pretty clear field for the development of new tools and new techniques. Crimping, riveting, flanging, brazing, spot welding and other common factory methods depend upon specialized technical tools which could be easily adapted to construction job use. And out of their adaptation we might develop a host of job methods that would not only speed the work, but would produce a far better installation, stronger assemblies and more secure grounding continuity.

THE TECHNOLOGY OF ELECTRICAL CONSTRUCTION is on the march. Systems and equipment are growing more complex and more extensive. The know-how and skills needed are greater than ever. And that progress deserves a parallel development in tools and techniques. It will take not only a new order of ingenuity in job management, but close cooperation with the manufacturers of the materials, components and equipment that go into the job. Both as a craft and as an industry, electrical construction and installation is rising higher in the technical scale. It needs technical tools.

Wm. T. Stuart

Electrical Contracting — AUGUST, 1946

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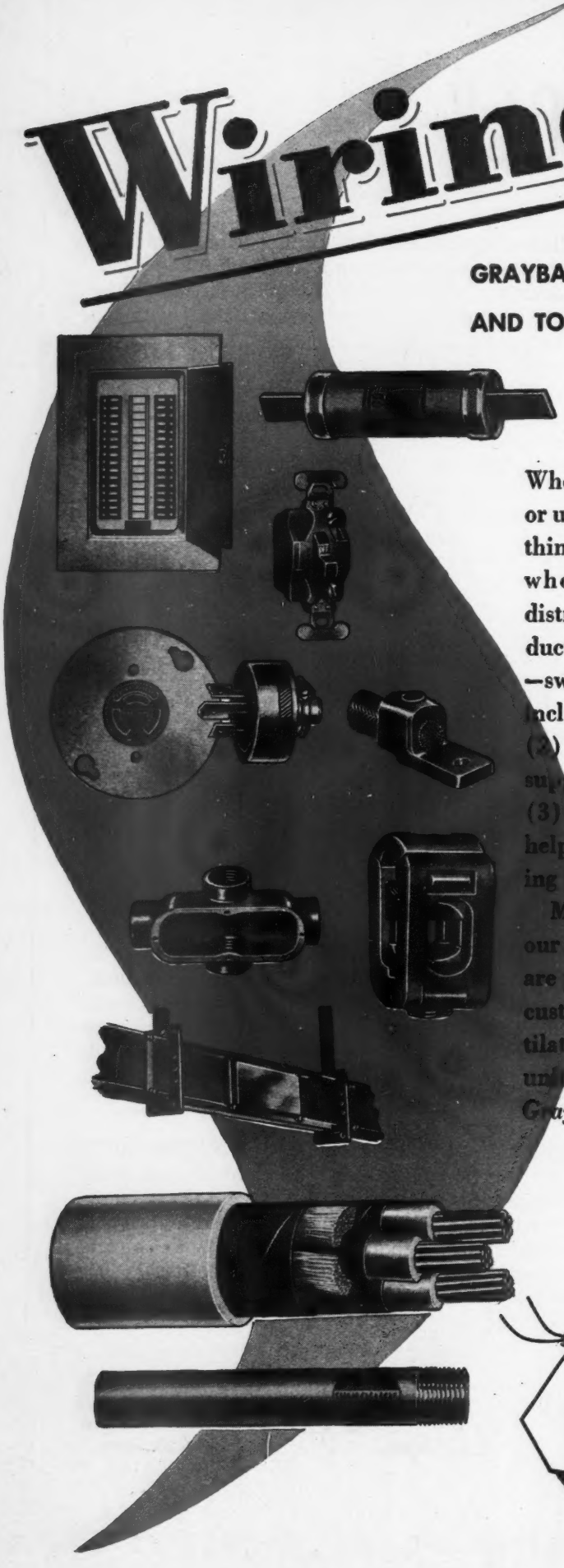

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WIRING for QUICK CHANGE

FIG. 1—Close spacing of troffer units in engineering department provides 150 foot-candles of illumination on the boards.

Networks of floor sleeves and over-ceiling catwalks permit quick relocation of circuits for revised machine groupings at Woodward Governor plant.

FIG. 2—Two-piece fixture simplifies catwalk maintenance. Flanges on fixture body slide over reflector rim mounted to suspended ceiling. Thumb-screw bolts hold it in place.

By August Eckel

OPERATING efficiency—a broad term embracing the ability to quickly shift machine groupings to conform to a revised production schedule or the manufacture of a redesigned product—is of greatest concern to the plant or production engineer. To attain this, the plant layout and the electrical system must be readily adaptable to such relocation as may be necessary.

This problem, however, does not worry the plant engineer of the Woodward Governor Company. Much of it has already been solved by the design of the ultra-modern windowless, air-conditioned plant they occupy at Rockford, Illinois—a credit to the engineering acumen of Woodward executives and technicians and the Harza Engineering Company, Chicago consulting engineers. Many Woodward suggestions, based on years of patient study and observation coupled with three-quarters of a century of manufacturing experience, were incorporated in the Harza design. Keystone of the layout is flexibility, particularly in electrical distribution.

In laying out the manufacturing areas, the paramount idea was to keep all work areas clear of piping; conceal all trunk wiring and yet have it adaptable to grouping flexibility for "quick shifting" of production machinery; provide high intensity lighting with fixture installation adaptable to quick rearrangement. How this was accomplished will be outlined in the following discussion.

One unique feature of the electrical design is the use of a single-voltage system for both power and lighting distribution. Reputedly rare in this section of the country, the system consists of a 230-volt, 3-phase, 3-wire, delta-connected secondary distribution with one leg (phase B) solidly grounded at the transformer. Lighting service originates at the same secondary buses as the power—no separate transformers being used.

Plant service consists of a 13,800-volt, 3-phase utility line terminating at a bank of three 500-kva., 13,800/230-volt, single-phase transformers with five 10-percent taps on the secondary side. Primary windings are delta-connected to the hi-line; secondaries delta-connected to the distribution buses with one corner of the delta (phase B) solidly grounded (see Fig. 4). System flexibility begins at this point. If one transformer fails, the plant can still operate at about 56 percent electrical capacity on an "open-delta" or V connection until the unit is repaired or replaced.

Secondary buses from the transformer vault feed a Westinghouse cubicle type switchboard consisting of 34 power cir-

FIG. 3—Compact floor connection to a machine. Service to this unit includes a dual air connection, a-c circuit, and d-c circuit for spindle speed drive and magnetic chuck.

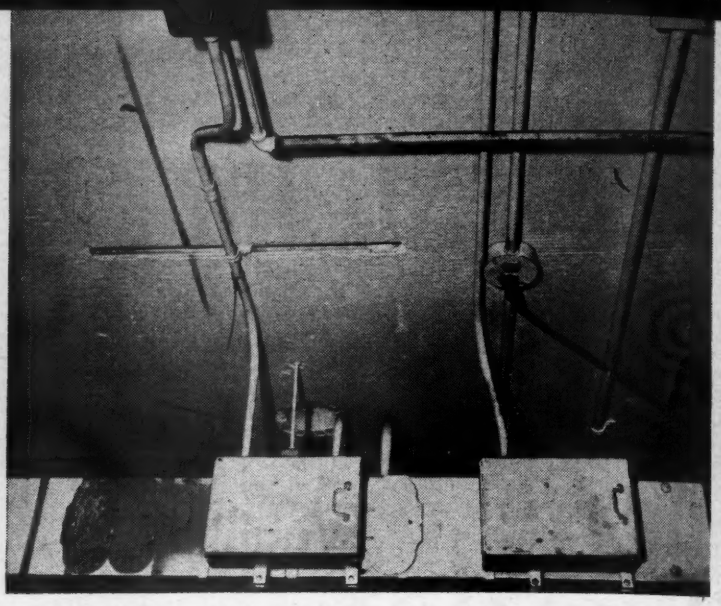


FIG. 3-A—View of the underside of a floor ceiling showing a-c connection to bus duct on basement ceiling. Other pipe is an air line. Bus ducts are spaced about 30 feet apart.

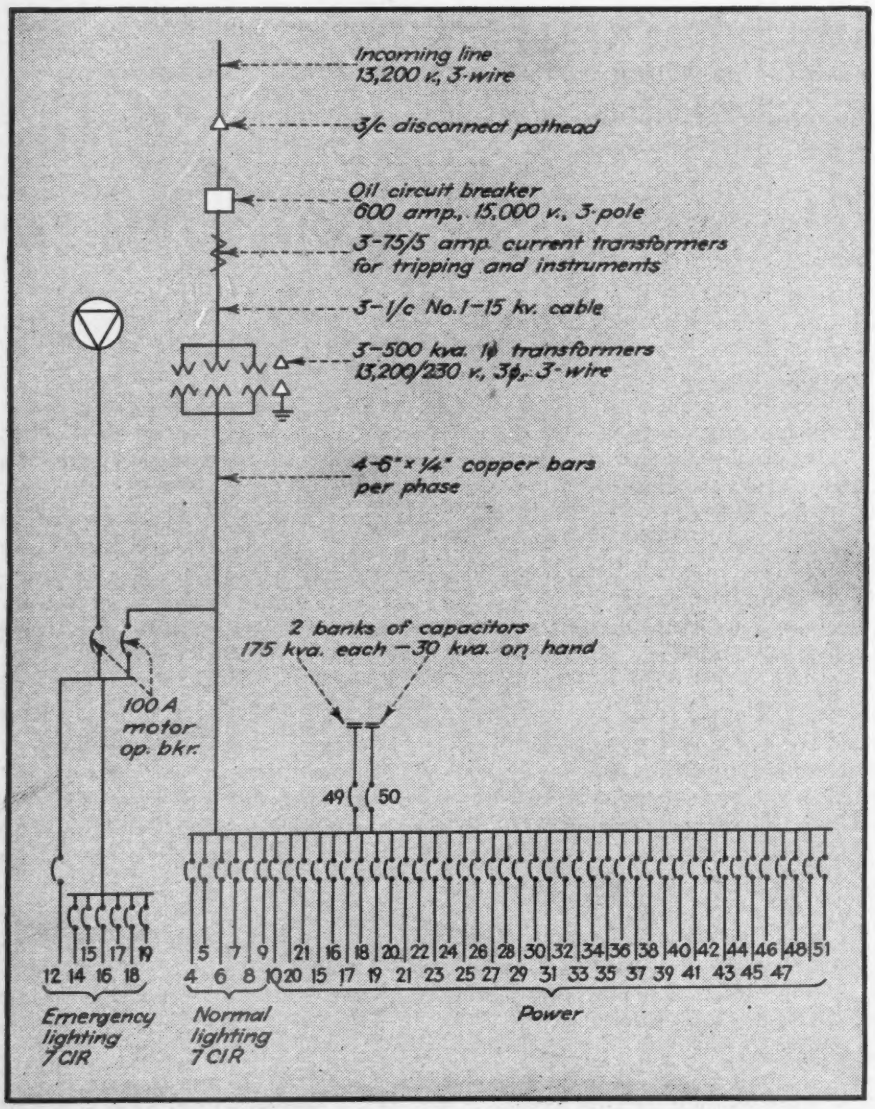

Incoming line
13,200 v, 3-wire
3/c disconnect pothead
Oil circuit breaker
600 amp., 15,000 v., 3-pole
3-75/5 amp. current transformers
for tripping and instruments
3-1/c No. 1-15 kv. cable
3-500 kva. 1ϕ transformers
13,200/230 v, 3ϕ, 3-wire
4-6" x ¼" copper bars
per phase
2 banks of capacitors
175 kva. each—30 kva. on hand
100 A
motor
op. bkr.
49
50
15 17 19
12 14 16 18
5 7 9 21 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 51
4 6 8 10 20 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47
Emergency
lighting
7 CIR
Normal
lighting
7 CIR
Power

FIG. 4—One line diagram of the power and lighting distribution system. Note delta-connected secondary with one phase grounded; also the 230-volt, 3-phase lighting with emergency generator service.

cuit breakers, seven lighting breakers and two interlocked units for emergency and utility automatic changeover on power failure. As an emergency standby, a 30-kva., gasoline-driven generator serves seven circuits feeding the emergency section of each lighting panel (see Fig. 6).

A plant power factor of better than 90 percent is maintained through 390 kva. of capacitors installed in a room adjacent to the main switchboard. In all there are nine 30-kw.; two 15-kw.; and two 45-kw. units arranged in two large banks controlled by breakers at the switchboard. Individual switches on each unit permits any desired number to be in or out of service.

Special voltages required for experimental work are obtained from autotransformers. Direct current, for spindle speed drives and magnetic chucks on grinding machines and other machine tools, is obtained from rotary converters located in the boiler room.

Power Distribution

Power for the main machine shop area (160 ft. by 224 ft.) is provided by six parallel runs of bus duct mounted *under* the shop floor (suspended from the basement ceiling). These 375-amp., 230-volt, 3-phase duct lines are spaced on about 30-foot centers (see Fig. 3-B). Branch circuit conduits from the duct go up through the floor to the individual machine. A thermal circuit breaker disconnect at each machine and a fused "plug" at the bus duct constitute the individual circuit protection.

Woodward is one of the few plants

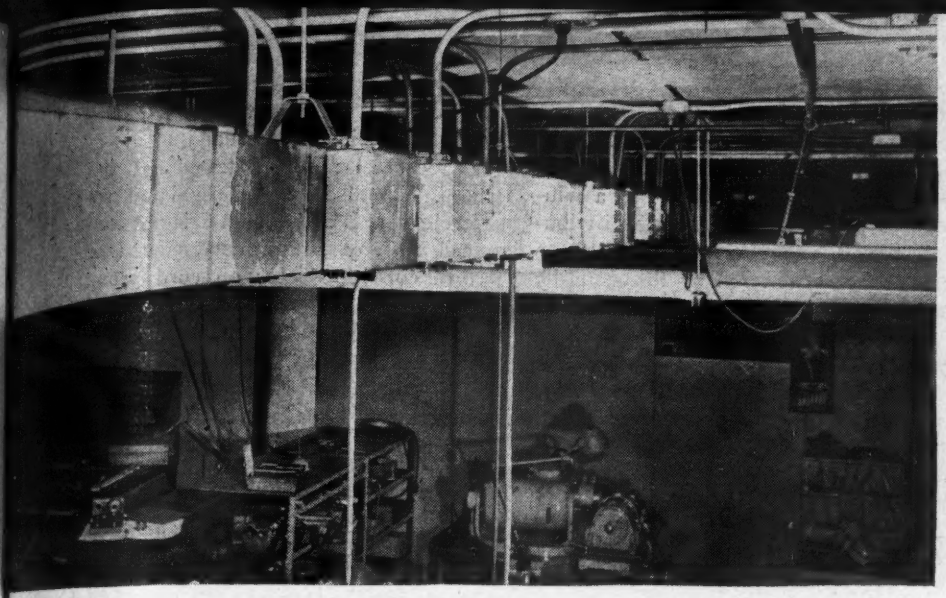


FIG. 3-B—One of the bus duct feeders under the machine shop floor. Branch circuits feed numerous machine tools above floor.

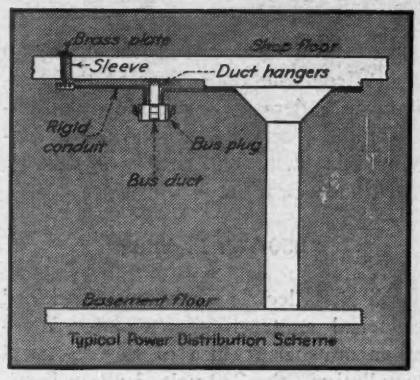


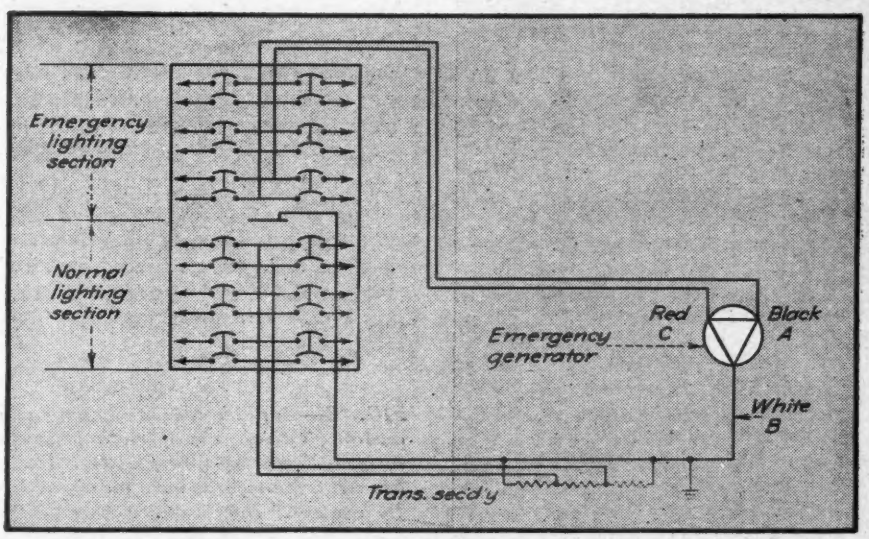
FIG. 5—Typical under floor bus duct power distribution scheme. Note access sleeve to machine shop floor.

FIG. 6—Typical lighting panel diagram showing normal and emergency section connections.

that do not bolt machines to the floor. They are simply mounted on "free" channels or rest on insulating blocks—a method that eliminates any transmittal of vibration to the floor and through it to another machine. Working on comparatively small materials parts with comparatively heavy machinery plus properly balanced motors and machine parts, permits this without the danger of the unit "walking" during operation. One major advantage, however, lies in the ease of shifting machines when production rearrangement is necessary.

To simplify electrical connections during regrouping of machines, Woodward engineers incorporated in the building design a network of "access sleeves"—4-inch diameter openings spotted on approximately 54-inch centers throughout the shop floor. The slab is of sufficient thickness to permit this. Each sleeve is capped with a brass floor plate (bushing with a screw-cover plate) grouted in the opening to prevent oil and water seepage into the basement. Each plate has three flush screw plugs which are removed when a-c, and d-c, and compressed air connections are made to the machine. Thus, regardless of where a machine might be set, there will be an access sleeve within a few inches of its base. If, as sometimes happens, the sleeve comes under a relocated machine, a new hole is drilled into the floor with a boring machine.

Above-floor connections to the machines are made with rigid or flexible conduit. (Fig. 3). Rigid conduit extensions go through the sleeve to a small pull box (Fig. 3-A) then on to the fused plug on the bus duct feeder. Direct-



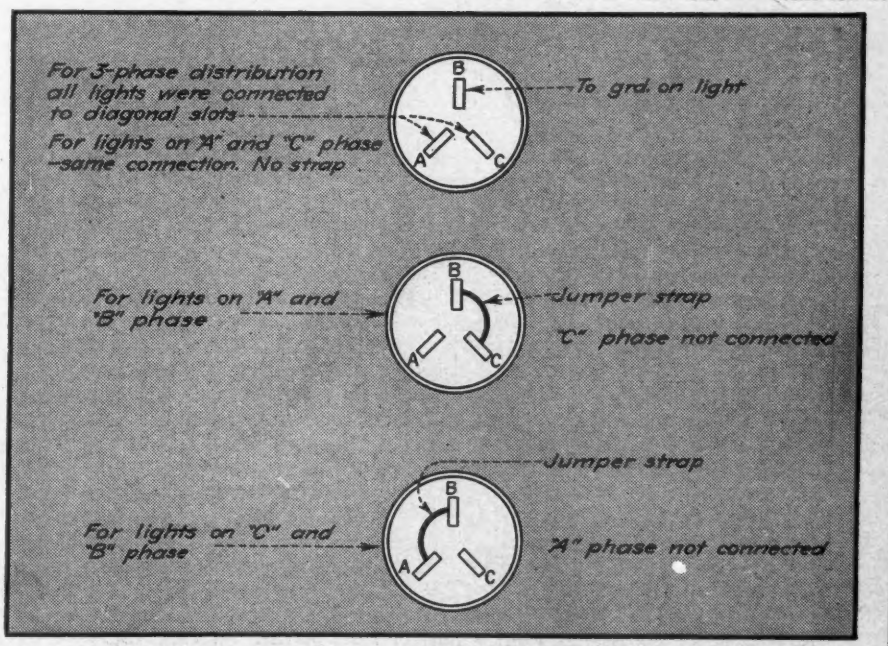

For 3-phase distribution all lights were connected to diagonal slots
For lights on "A" and "C" phase —same connection. No strap
To grd. on light
B
A
C
For lights on "A" and "B" phase
Jumper strap
"C" phase not connected
Jumper strap
For lights on "C" and "B" phase
"A" phase not connected

FIG. 7—Basic arrangement of 3-wire receptacle connections to the 230-volt, 3-phase lighting distribution. Slot B is always connected to grounded phase.

current and compressed air lines go direct from the floor plate to their respective feeders. The combined flexibility of the access sleeves and the underfloor bus duct considerably speeds up machine relocation.

230-Volt Lighting

Wilson Electric Company, Rockford electrical contractors, encountered another unusual feature of the electrical installation—the 230-volt, 3-phase lighting distribution. As illustrated in Figs. 4 and 6, the lighting comes direct from the main switchboard buses. Separate feeders are used, however, to isolate the lighting from a possible power circuit failure—an important feature in a windowless plant. Also, lighting distribution panels are equipped with a top emergency section fed by the stand-by generator.

The 230-volt, 3-phase delta-connected system is carried right to the lighting outlet. Fixture connections are made with 3-wire cord plugs and receptacles. Equal balancing of the lighting load on the three phases was accomplished at the receptacles by connecting the circuit conductors as shown in Fig. 7. The vertical slot was always connected to the grounded phase-B conductor; the diagonal slots to either phase A or phase C, depending upon which circuit phase was to serve the fixture. Internal jumpers in the receptacles were installed to assure that one side of the fixture connection was always on the grounded phase conductor. The third wire in the cord provided the ground to the fixture body. With the circuit conductors of the fixture always connected to the diagonal prongs of the cord plug there was ample protection against unbalancing when units were replaced, repaired, or removed for maintenance. There is only one way to insert a 3-prong plug. It cannot be reversed.

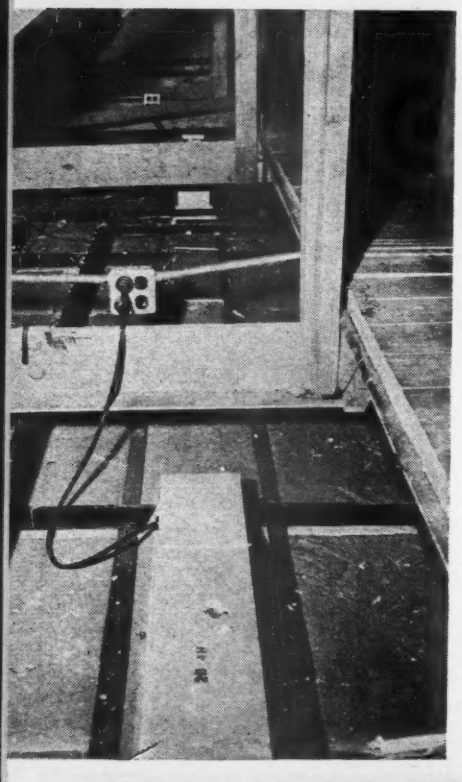


FIG. 8—Double, duplex receptacle outlet (3-wire) above ceiling serves machine shop lighting fixtures. These branch circuit outlets are on about 10-ft. centers. Note service catwalk at right.

FIG. 9—Chief electrician Walter Larson rests fixture on catwalk while he changes lamp. If major repairs are necessary, unit goes to shop and new one is installed in a jiffy.

If we follow the diagram in Fig. 7 we find that units connected between phases A and C require no internal jumpers in the receptacle; for fixtures between phases A and B, a jumper bond receptacle slots B and C, and C is not connected to any circuit conductor (the fixture cord conductor on cord prong C is really connected to the grounded phase B through the receptacle jumper). By the same token, receptacle slots A and B are bonded by a jumper for units connected between phases C and B, phase A not being connected.

Concealed Troffer System

To eliminate the old "factory" atmosphere and the inherent noise that accompanies normal machine shop operation, practically the entire plant was designed with a suspended Perfatone acoustic ceiling—a perforated metal tile (12-inch square sections) with an absorptive pad backing. Shop walls are green and light yellow glazed tile; the acoustic ceiling ivory. In the offices and engineering sections, plaster walls are painted light green; the acoustic ceiling white.

Plant lighting is almost 100 percent fluorescent with the 100-watt (two 40-watt, 3500-degree white lamps) troffer type Sylvania unit predominating. The 100-watt fixture—occupying the space of four removable Perfatone ceiling sections—is adaptable to flush mounting and provides the desired flexibility when greater concentrations of light are needed in specific shop areas. Ceiling panels are simply removed and additional lighting fixtures installed where needed.

General lighting in the shop area is of 50 footcandle intensity (initial with new lamps). Rows of fixtures, on six-foot centers, are mounted flush in the 14-foot ceiling. End-to-end distance between units is three feet. Fluorescent units in the crane bay are mounted flush in the 22-foot suspended acoustic ceiling. Lighting circuits (with 12 to 14 fixtures per circuit, 24 in crane bay) are controlled by circuit breakers located in flush wall panels.

Where high intensity illumination is necessary for inspection of precision parts, localized fluorescent units are installed about 3-feet above the working plane.

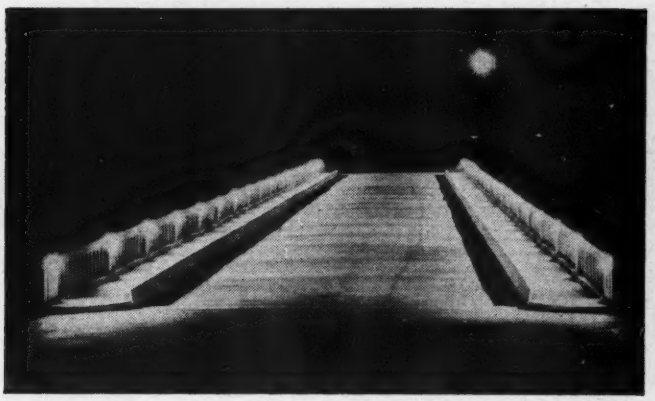
In the engineering department (Fig. 1), 150 footcandles (initial intensity) of general lighting is installed flush in the 10-ft., 6-in. suspended acoustic ceiling. Rows of fixtures, on two-foot centers, parallel the width of the room; distance between ends of fixtures is three feet. Other office fixture spacing varies de-

[Continued on page 146]

Bridge Handrail Lighting

Designed lighting cuts construction costs, maintenance man-hours and total power load. New fixtures raise intensity of pavement illumination while reducing glaring source brightness.

Conventional pole mounted viaduct lighting, utilizing high wattage lamps at wide intervals, provides low intensity illumination to roadway pavement, creates dangerous glare and boosts total power consumption.



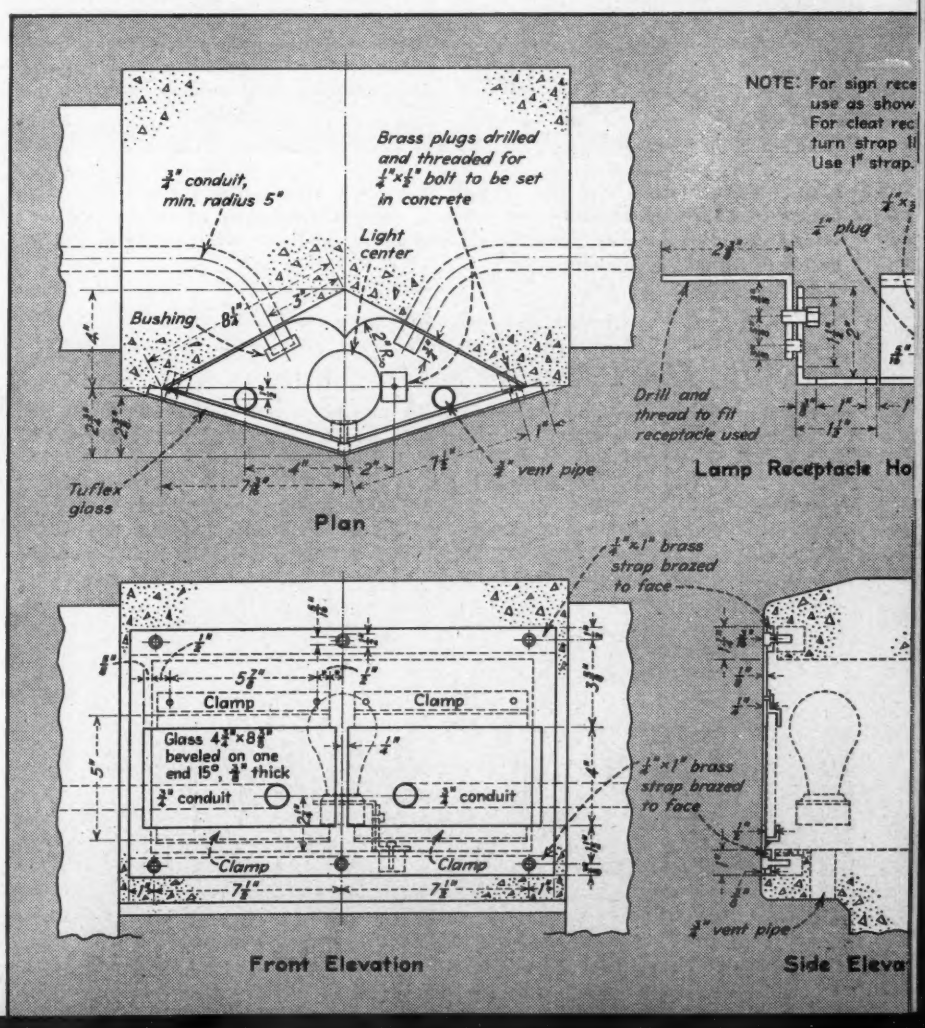
New bridge handrail lighting lowers lamp housings to readily-maintained positions, directs useful light to pavement, reduces load by using more lamps of lower individual consumption, and eliminates excessive conduit runs.

HANDRAIL lighting is making a definite contribution to more efficient bridge illumination. It is improving visibility and safety while cutting construction costs, maintenance man-hours and electrical consumption. This trend has been incorporated in the relighting plan of the 30th Street Bridge, Tacoma, Washington. The lighting design was originated and installed by the Public Utilities Department of that city. Future plans in the Tacoma portfolio will follow this progressive stride and will be improved by several minor alterations which this initial installation has indicated as being in the interest of even greater lighting efficiency.

Illumination formerly emanated from widely spaced, pole elevated, globe enclosed, non-directional, high wattage lamps. This design is still employed on the viaduct around Tacoma's City Hall (Fig. 1). High wattage, high brightness lamps create glare and introduce an element of danger. This is especially true on curved ramps similar to the illustration. Non-directional globes allow light to radiate in all directions, lighting surrounding buildings as well as the bridge pavement. The intensity of useful light on the roadway is reduced by the law of dispersion and the lighted areas bordering the ramp tend to distract the motorist's attention. Tall lamp standards increase the volume of necessary construction materials, conduit and wiring. Maintenance man-hours are greater due to the necessity of using ladders or mobile towers for lamp replacement and

[Continued on page 150]

Dimensions and Wattage can be safely reduced in future installations. Changes will result in lower construction costs and power consumption.



LIGHT and COLOR ACCENT FIFTH AVENUE STORE

John David's new store on New York's smart Fifth Avenue uses stage lighting methods for window display, and modern planned lighting methods for interior lighting

FIG. 1—Continuous lighting trough four feet wide follows store contour, provides over 50 footcandles of general illumination with white fluorescent lamps, in first floor of John David's new store. Forty watt daylight lamps are used in wall case cove.

FIG. 2—Continuous trough fluorescent lighting on second floor provides 60 footcandles on clothes racks when pulled out from wall recesses. Incandescent center lights improve color quality of lighting.

JOHN David, Inc. has set a new pace in light for selling. Lighting methods used in the newest unit of this New York chain men's haberdashery will influence store and display lighting nationwide. Opened in time for the 1946 Easter parade, the show window and interior store lighting is already the talk of the town, and of all lighting men who have seen it.

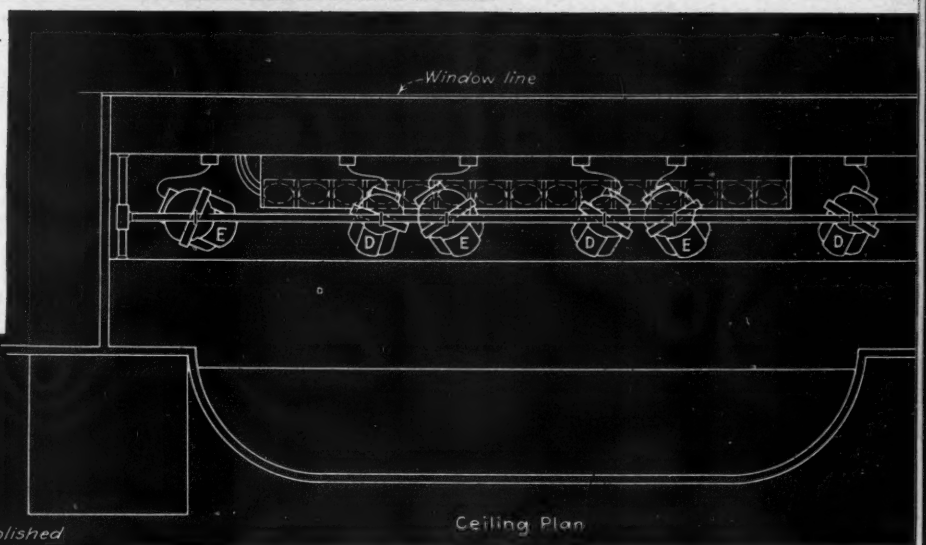
The *lighting techniques,* both in the show windows and in the store interior, are not new. The completeness of the job, and the intelligent integration and correlation of all lighting details, functionally, are the factors that make this lighting revolutionary. Cost of the electrical installation, including cost of lighting equipment, control equipment and wiring represents over 30 percent of the total construction cost of the store—a new high for any type of establishment.

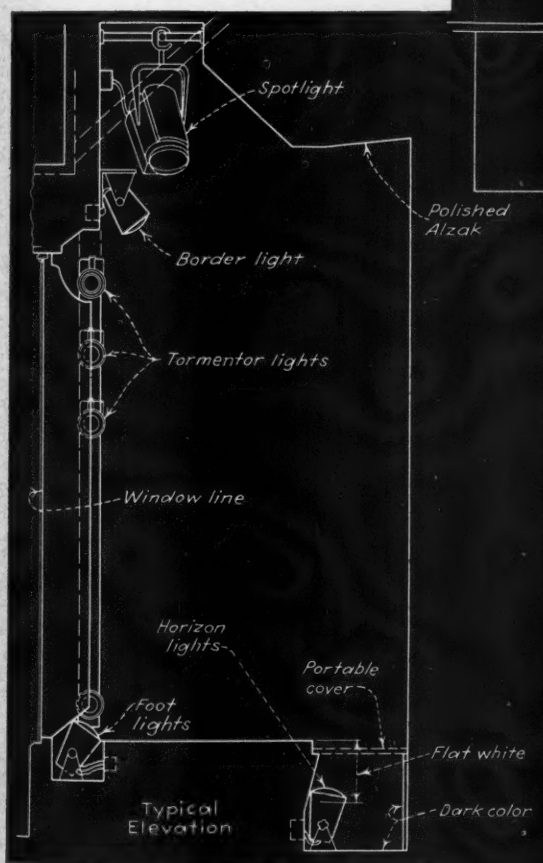
The store has 14 show windows, four on Fifth Avenue and ten on 49th Street. Stage lighting techniques, and typical stage lighting units, are used to light these windows. Horizon lights, borderlights, drama lights and footlights are used to "paint" the neutral tone window backgrounds in any desired color, dramatically, with the arresting power of the stage. Spotlights and "tormentor" lights accent the merchandise display with beams or floods of white light.

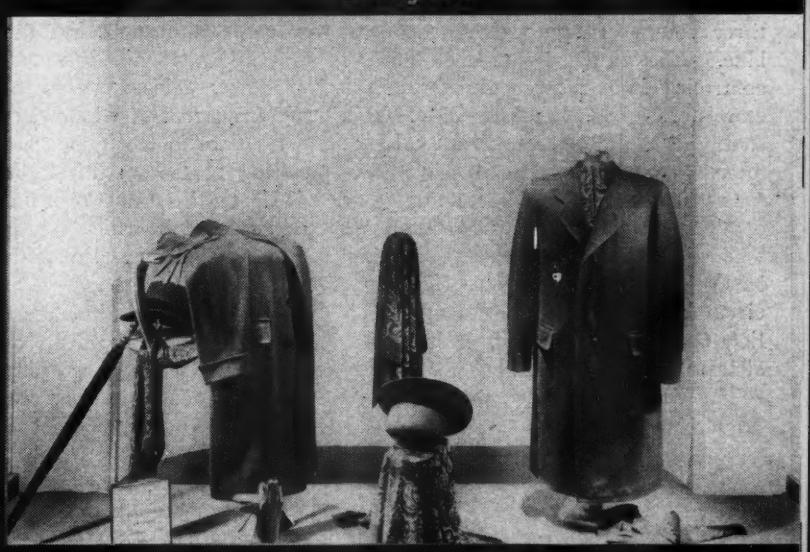
A three months' "clock" check of traffic showed that an average of over one-quarter million people pass this corner daily. These potential customers comprise local and visiting shoppers of New York's nearby smartest shops, also employees and visitors of nearby Radio City, and heart of Manhattan. Day or night, none can pass this corner without consciously or unconsciously seeing these colorful and dramatically lighted displays. No survey has as yet been made to determine what percentage of

By
Berlon C. Cooper

FIG. 3—New John David store occupies first and second floors in prominent corner building at Fifth Avenue and 49th Street, New York City. Each of the 14 show windows are color lighted following stage lighting techniques.







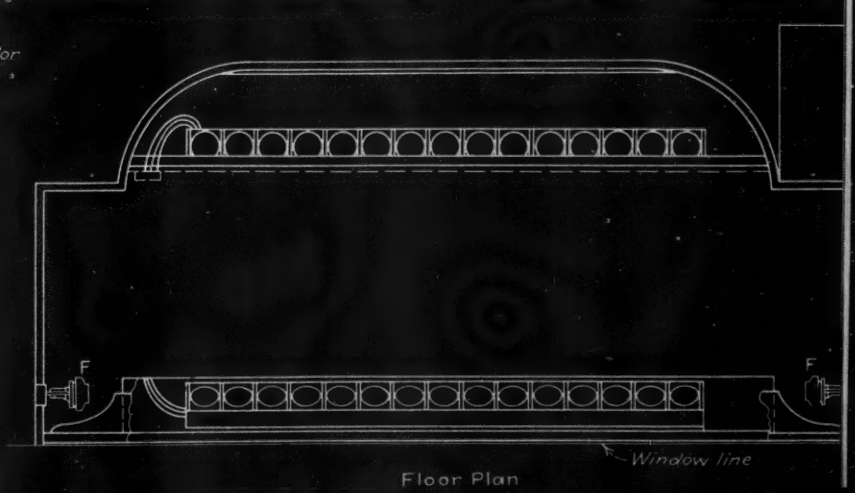


FIG. 4—Typical details of theatre lighting techniques applied to show window lighting. Note picture frame effect in photo, which conceals spotlights and borderlights overhead, "tormentor" lights on side, and footlights. In rear of window horizon lights are used to "paint" background.

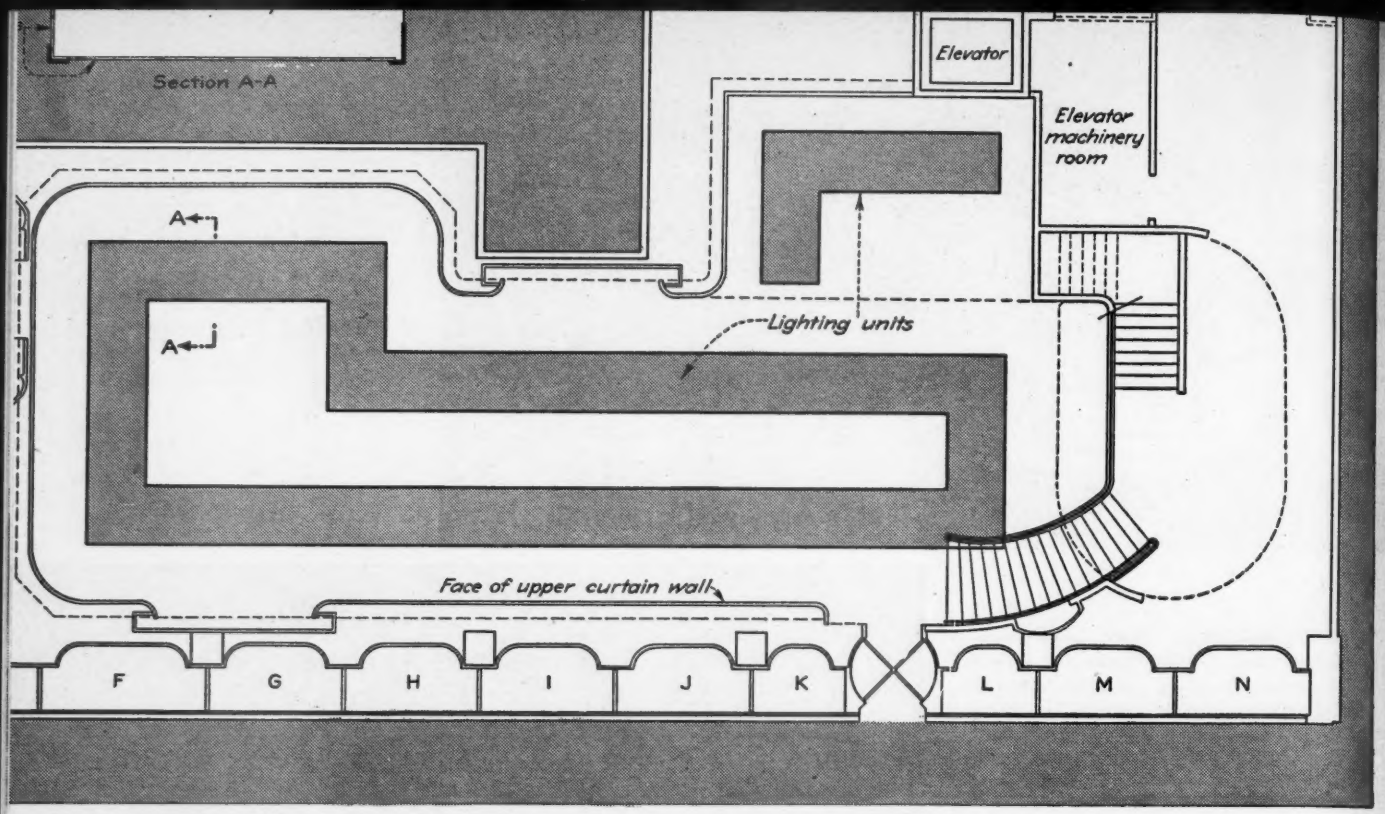


FIG. 5—Ceiling plan of first floor over balcony, and plan of show windows. Detail in upper left shows typical section through lighting fixture. Continuous lines of 3500° white flu orescent lamps are installed on approximately 7-inch centers.

sidewalk pedestrians stop to view these windows. Any casual observer will note, however, that many more people stop at these windows than at other less attention-compelling windows in the neighborhood.

Each show window is provided with three colors of light: red, green and blue. All colored lights are dimmer-controlled from a large dimmer in the store's basement. White light, from spotlights and "tormentor" units, is not dimmer-controlled. The display director uses a telephone to direct an operator at the dimmer panel inside the store, when selecting the desired color and background in each window. Telephone circuit outlets are installed in the mullion between plate glass, easily accessible to the displayman.

The control panel for the dimmer is arranged in 14 sections, one for each window. Each section controls three circuits, one for each color. The cost of this dimmer and control panel alone was over $8000 (Fig. 6).

FIG. 6—Dimmer bank for show window lighting is located in basement. Display director on street uses telephone to direct operator in establishing proper color background for each of 14 windows. Note individual circuit controls at top of board.

The show windows have 140 linear feet of front footage, and occupy 855 square feet of floor space. A total of 171 kilowatts are installed in the 14 windows. This amounts to 1220 watts per front foot of window, or 200 watts per square foot of floor space. The resulting heat from this lighting load is dissipated by means of a forced ventilation system, in which cold air is drawn in at the bottom and out through grilles at the top of the windows. As a safety precaution against damage to merchandise due to heat, the electrical contractor has installed air flow switches in both the supply and exhaust ducts. These airflow switches prevent the window lights from being turned on when no air is circulating through the windows.

Lighting equipment is concealed in corner windows by means of valances. All other windows are equipped with frames (Fig. 4), which conceal spotlights, borderlights, tormentor lights and footlights. Horizon lights are recessed below the floor level at the rear of windows, and the equipment recess is painted the same color as the floor. This recess is therefore unnoticeable to the lay customer. A concentrated beam of light from each reflector in the horizon light strip paints its color on the window background. In order to increase efficiency and provide a uniformly lighted background, a 15-inch wide sheet of polished aluminum is installed in the ceiling adjacent to the background, tilted to a slight angle. This polished surface reflects spill light downward onto the background, smoothing out the illumination.

Two sets of spotlights are installed in each window, one for daytime use to combat daylight plate glass reflections, the other for night use. Daytime spots each use a 1500 watt lamp, while a 500 watt lamp spot is used at night. These spotlights are used for accenting the merchandise with white light. Tormentor lights consist of 150 watt PAR-38 lamps installed behind the frame on each side of the windows, in a housing equipped with spill light rings, and are used to supplement the overhead white spotlights. Merchandise is thus displayed under intense white light, showing it in undistorted light against the colorful background.

The background, sides and ceilings

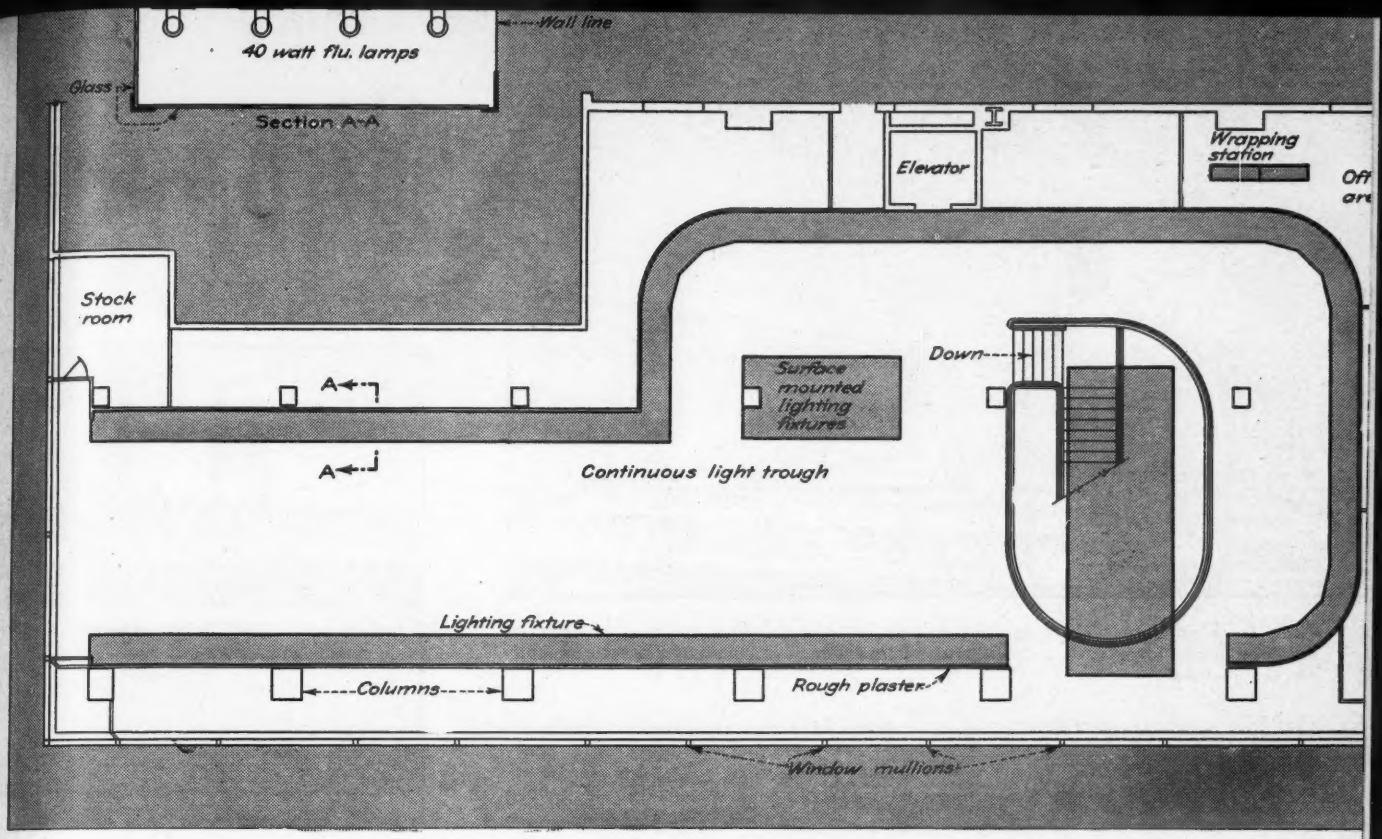


FIG. 7—Second floor plan showing lighting layout. Lighting trough at wall line is over suit racks when pulled out of wall recesses. Detail below is of incandescent units located in center of ceiling.

of all windows are finished in a neutral flat tone of paint. This type finish permits background to be "painted" any desired color by the colored light—either pure colors, or tints obtained by mixing the colors. This feature eliminates the so-called "sets" which have to be replaced each time windows are redecorated in the average store window lighted with white light only.

This window lighting system has been designed for maximum flexibility in display and lighting effects. Ample lighting units are provided in each window to permit the display director to ignore background effects when planning his merchandise display. The correct background effect can be obtained through manipulation of dimmer and switch controls after the displays are in place.

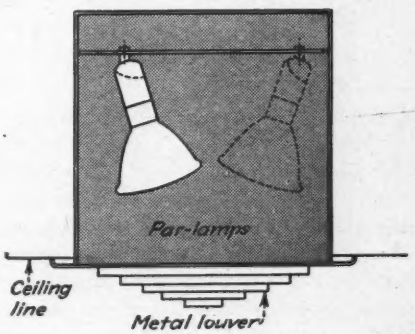
The window lighting was designed by Stanley R. McCandless, noted theatre lighting specialist and lighting consultant. The window lighting equipment was furnished by Century Lighting, Inc.

Interior illumination of the new John David store is based on large area, low surface-brightness units for general illumination. Wall cases are lighted by a continuous line of fluorescent daylight lamps, recessed in a small decorative cove (Fig. 1). All floor showcases are lighted with standard white 30 watt fluorescent lamps in small, neat showcase reflectors.

General illumination on the first floor is obtained from one large lighting fixture which covers practically the entire ceiling. It is 4 feet wide, continuous, and conforms to the architectural shape of the room (Fig. 5). It is installed on the surface of the ceiling, and extends down 10 inches. The ceiling between the continuous glass pattern is at the same level as the bottom of the lighting unit. Glass sides surround the entire lighting unit, which provides a low intensity of light on the remaining portion of the ceiling.

At the rear of the store is a curving stair case, leading to the second floor. The complete ceiling on the second floor over the stair well is glass, forming the effect of a skylight. This large area of glass 9 feet wide by 25 feet long, is illuminated to a very low intensity, which provides an ample intensity of illumination on the stairway.

Lighting on the second floor is strictly functional, and accentuates the architectural shape of the room. Clothes racks are recessed in the wall space. At the junction of the wall over the racks and the ceiling, a continuous lighting unit 9 inches deep and 25 inches wide, extends around the entire room (Fig. 7). When a rack of suits is pulled out of its wall case, it is directly under this continuous lighting trough. Illumination on the suits is in excess of 60 foot-candles (after three months of burning). A row of louvered recessed reflectors is provided down the center of the ceiling.



The resultant lighting is of excellent *color quality,* shadowless, and free from glare. The mat white ceiling, light ivory side walls and bleached finish furniture and cases provide excellent brightness ratios. Seeing is thus made easy, and customers are not conscious of the lighting units—a good test of the effectiveness of a lighting system.

Interior lighting was planned by Kenneth C. Welsh, illuminating engineer for Grand Rapids Store Equipment Company, who designed the store. Gruber Bros. interpreted the lighting plans into equipment to meet the specific structural details and lighting requirements.

Electrical contractors for the entire John David store were Lowy and Donnath, of New York City. They engineered all wiring details and installed all wiring and lighting equipment. They also installed wiring for five 7½-ton air conditioning units used to air condition the entire store.

Supports

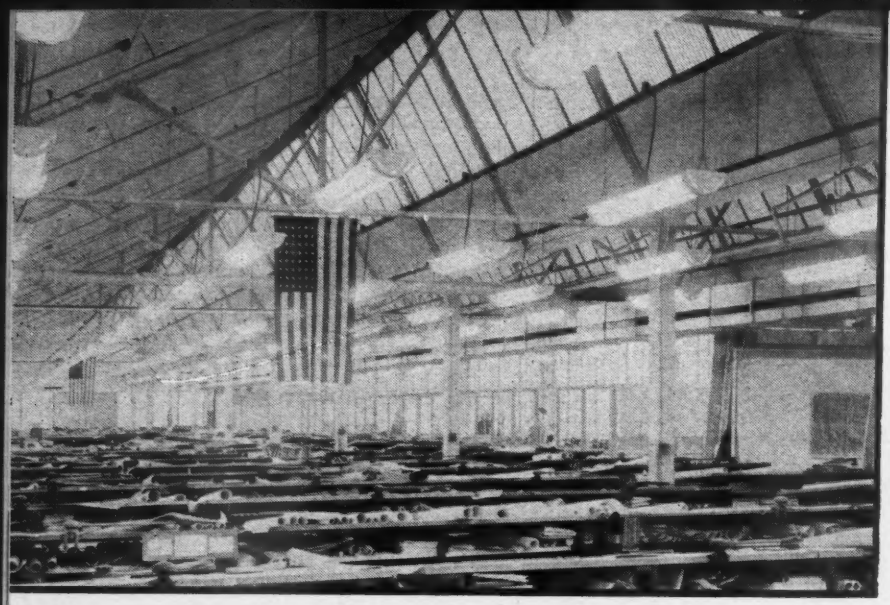


FIG. 1—Fluorescent lighting installation in this drafting room is supported and fed from long runs of Unistrut. Clear channel of strut forms the conductor raceway.

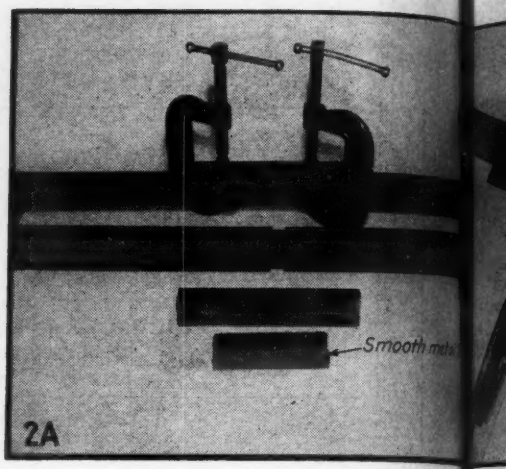


FIG. 2—Sections of Unistrut were welded to form continuous channels. Clamping fixtures hold strut in place for straight sections (A); cross joints (B); and offsets (C). Note smooth metal liner (A) for interior of channel at welded joint.

Caterpillar Tractor Co. engineers use structural framing as a combined fixture support and conductor raceway.

A STUDY of an existing fluorescent installation made by F. C. Gedge, plant engineer of Caterpillar Tractor Co. in Peoria, Illinois, ultimately led to a new approach to lighting circuit distribution. The maze of chains, conduits, cords and supporting rods suspended from the saw-tooth roof of the building suggested a need for a wiring system that would meet the following requirements:

1. Have the structural strength to support fluorescent fixtures over a 10-ft. span.
2. Be a combination supporting medium and conductor raceway.
3. Make wiring easily accessible for quick addition of outlets.
4. Be neat in appearance.

Unistrut, a structural framework designed for supporting electrical apparatus, was chosen for its structural strength and the fact that its $1\frac{5}{8}$ in. square channel provided raceway space for the wires feeding the supported fixtures. Although designed primarily as a structural member (See "Simplified Supports," E. C., Nov., 1945, pg. 56) there appeared to be no practical reasons precluding its application as a conductor enclosure. Being furnished in 20-ft. lengths, it met the long-span requirement; the channel section, with its smooth interior and a snap-on cover on the open slot, provided a roomy raceway. By adapting feed-in boxes and receptacles to strut mounting, the distribution scheme was complete.

One of the first installations was made

NOT AN *APPROVED* RACEWAY

It is our established policy to limit major articles about wiring jobs to those which employ "approved" materials and methods. This is a practical journal and the practices reviewed must be acceptable to inspection authorities.

This is an exception, an entirely proper exception to that policy. Unistrut is not approved as a raceway under the Code, nor has it been submitted by the manufacturers for approval.

Competent engineers in this plant — and a few others, however — have advantageously utilized the empty channel (when strut is used as a long-span fixture support) to enclose circuit conductors. It was installed and is being maintained by competent mechanics.

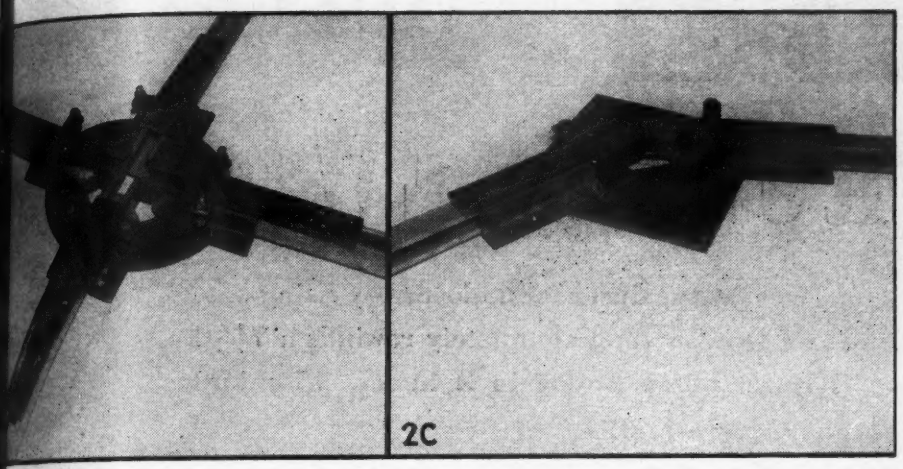
These engineers have opened a new practical approach to a particular raceway problem. Their experience indicates that this method affords the same safety features as conventional raceways—plus added structural strength and outlet flexibility. Apparently no maintenance problems have been encountered with this installation.

With the subsequent development of suitable fittings to make channel-free connections of the sections and other minor refinements, it may easily become an approved raceway of the future.

Right now, if the reader plans to use their material as a raceway as well as a structural support, the plans should be cleared with local inspection authorities.—*Editor.*

Form Raceway

By George E. Walters
Electrical Maintenance Foreman
Caterpillar Tractor Co.
Peoria, Illinois



in an office area in the plant. The installation discussed in this article was recently made in the drafting room of the engineering department (Fig. 1). The 250-ft. by 76-ft. area is served by twelve continuous rows of Unistrut, on 6-ft., 4-in. centers, running parallel to the length of the building. Each group of four rows is tied together at three different points by cross-feeds of strut.

The strut rests—open slot upward—on the bottom chords of the steel trusses, each 20-ft. section spanning one bay. Rods suspended from the saw-tooth roof at the mid-point of each bay provide strut supports on 10-foot centers throughout the area. U-bolts fasten the strut to the trusses.

Sections of Unistrut were welded together to make the continuous 240-ft. raceway. Each section was furnished with ends beveled to receive a welding bead which was ground down on the outside to make a smooth joint.

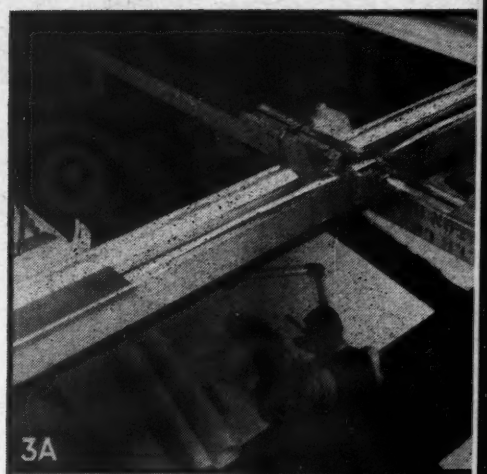
Smooth metal liners, inserted in the channel at each welded joint, prevent possible damage to conductor insulation at these junctions (See Fig. 2-A).

To facilitate welding of the strut, clamping fixtures were made for the "cross" (Fig. 2-B) and 45-degree offset (Fig. 2-C) as well as the straight-through joints. A single clamping fixture with necessary adjustable features could be fashioned to take care of all these welds, if desired. Figure 3-A illustrates a cross-run installed in the trusses (with cover sections removed to show wires); Figure 3-B, a 45-degree double offset with the covers intact.

Accessories used to make the necessary circuit connections to the Unistrut and the fluorescent fixtures include: Sheet-metal snap-on covers for the strut; thin-wall tubing and conventional utility outlet box (G.E. No. SP4800 with special clamping bars) to feed the run of Unistrut from existing outlets in the roof structure; two-wire receptacles (Wiremold No. 1127); right-angle attachment plug caps (Daniel Woodhead No. 1410); tubing connectors; fibre bushing (for conductors feeding strut); supporting rod and fixture hanger clamps; and fixture chain. All clamps and hanger attachments were fabricated in the plant sheet-metal shop.

Sections of Unistrut were fed from

[Continued on Page 152]



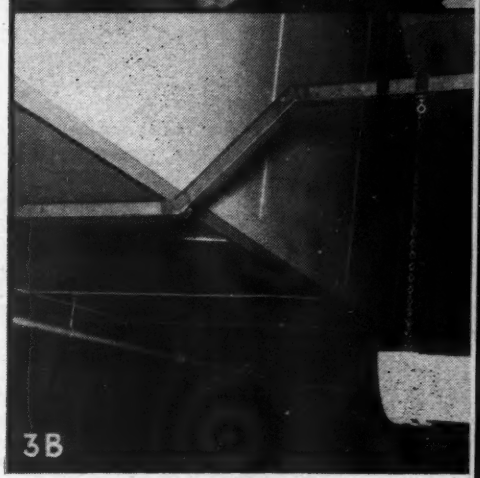


FIG. 3—Strut raceway—with covers off to show conductors at cross-tie—mounted to roof truss (A); also double 45-degree offset supported from ceiling (B). Note welded joints. Strut was later painted light color to blend with ceiling and walls.

FIG. 4—Raceway feed from existing outlet with thin-wall conduit and conventional utility box equipped with special bar clamps that grip interior of strut at open groove.

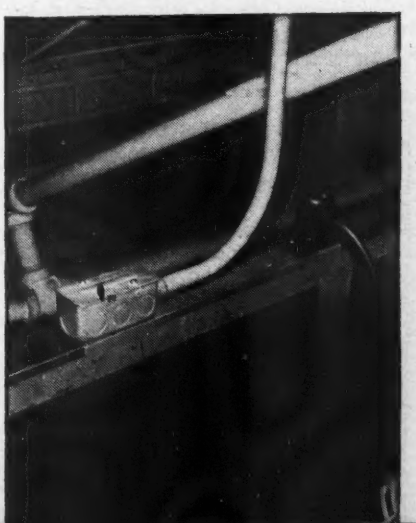


FIG. 5—Adding outlets to strut raceway is simple. Electrician removes snap-on cover, connects receptacle to conductors, cuts cover to fit and replaces it, hangs and plugs in fixture.

FIG. 1—Accurate file system contained coil winding data for emergency job. Fast winder completes set of coils in 30 minutes.

Speeding RUSH REWINDS

Working against time and steadily rising waters, an Oregon shop completely rewinds a 7½ hp. sump pump motor in 2 hours, 35 minutes.

FIG. 2—Shop worker cuts and forms slot insulation while old windings are stripped from stator.

FIG. 3—As coils and insulation are completed, coils are layed in stator slots; a two-hour operation.

THE combination of efficient shop organization, accurate reference files and excellent cooperation between experienced employees of the Reed Electric Company, Portland, Oregon, prevented a flood in the basement of Portland's Northern Pacific Terminal and focused attention on how this shop handles a rush winding job.

With their 3 phase, 7½ hp., 1800 rpm., 440 volt, sump pump motor out of operation due to a badly burned stator; no available spare, and rising waters in a sump pit with a 4-hour filling interval; the Terminal service department rushed the unit to the Reed shop. Since the allowable time limit for rewinding and reinstalling the motor was governed by the rate of water rise, the shop rose to the emergency while waters rose to the overflow.

Arriving on the shop floor, the motor was disassembled in five minutes and the heads, rotor and bearings cleaned with gasoline under pressure. A simultaneous checking of the files indicated that the unit had been previously repaired and listed in their shop. The necessary data pertaining to coils was located in two minutes and the fastest coil winder was instantly detailed to this operation. All coils were wound in 30 minutes (1). At the same time, slot insulation was cut and formed by another employee (2) while the stator was stripped and cleaned for rewinding.

As coils were completed, they were relayed to an electrician who layed them in the stator (an hour's job) (3) and made all necessary phase connections (30 minutes) prior to testing (4) and final assembly (5).

Due to the emergency nature of the work and the possibility of property damage in the event of not re-installing the unit before an overflow developed, the "Formvar" wire was left untaped and the dipping and baking steps deferred to the following week-end.

While testing was in progress the customer was phoned to "come and get it" and, two hours and thirty-five minutes after initially receiving the motor, the unit was ready for pick-up.

FIG. 4—Stator is tested for 2300 volts to ground and balance before final assembly of motor is undertaken. Work is approved only after completion of satisfactory inspection.

FIG. 5—Two hours, thirty-five minutes after receiving burned unit, rewinding of stator is completed and motor is assembled for re-delivery to customer.

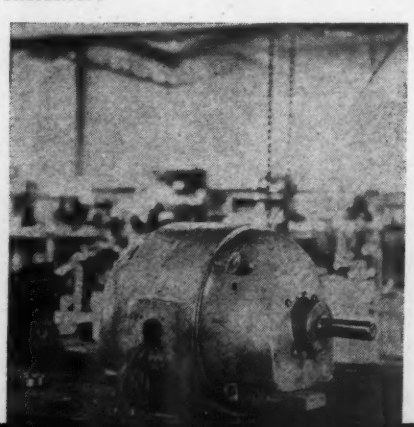


FIG. 6—Owner R. A. Reed (left) believes in personally following important jobs through his shop. He is shown with shop worker making phase connections of rewound stator.

Rewinding and Reconnecting A-C Motors—PART IV

By
Rouel G. Cazanjian
Electrical Engineer
Brooklyn, N. Y.

LAST month we described the frequency change in a single phase motor. Here we conclude the series with a discussion for changing the frequency of three phase motors.

The frequency change in a three phase to three phase winding is much simpler. The distribution factor does not appear. The following example will describe the method of calculating the chord factors and the new number of turns per coil. The other steps are as previously described.

Example.—A 10 hp., 1150 rpm., 208 volt, 60 cycle, three phase motor with squirrel cage rotor, 54 stator slots, and 54 coils of 25 turns each spanning 7 slots, is to be rewound for operation at about 725 rpm. on a 208 volt, 25 cycle, three phase supply.

The number of coils per phase is 54 coils / 3 phase = 18. The total number of 60 cycle turns per phase is 18 coils x 25 turns per coil = 450. The number of coils in each pole-phase group is 18 coils per phase / 6 poles = 3. The number of slots per pole is 54 slots / 6 poles = 9 which represents full pitch or 180 electrical degrees. The chord factor of this winding is $\text{Sin}(\frac{1}{2} \times 7/9 \times 180) = 0.940$. A similar winding with one of the phase-windings in place is shown in Fig. 7a.

In the 4-pole, 25 cycle arrangement, the number of slots per pole or full pitch is 54 slots / 4 poles = 13.5. A pitch of 7/9 or 77.8 percent may be obtained with a coil span of 13.5 full pitch slots x 0.778 = 10.5 slots. In eliminating the fractional slot, let us assume that we decide on a coil pitch of 10 slots spanning slots 1 and 11. The corresponding chord factor will be $\text{Sin}(\frac{1}{2} \times 10/13.5 \times 180) = 0.961$. The effectiveness of the winding is thus increased in the ratio of the respective chord factors, in this case, by 0.961/0.940 or 2.2 percent.

Inasmuch as the resulting number of coils per pole-phase group 54 slots / (3 phases x 4 poles) = $4\frac{1}{2}$ is not a whole number, it will be necessary to

[Continued on page 154]

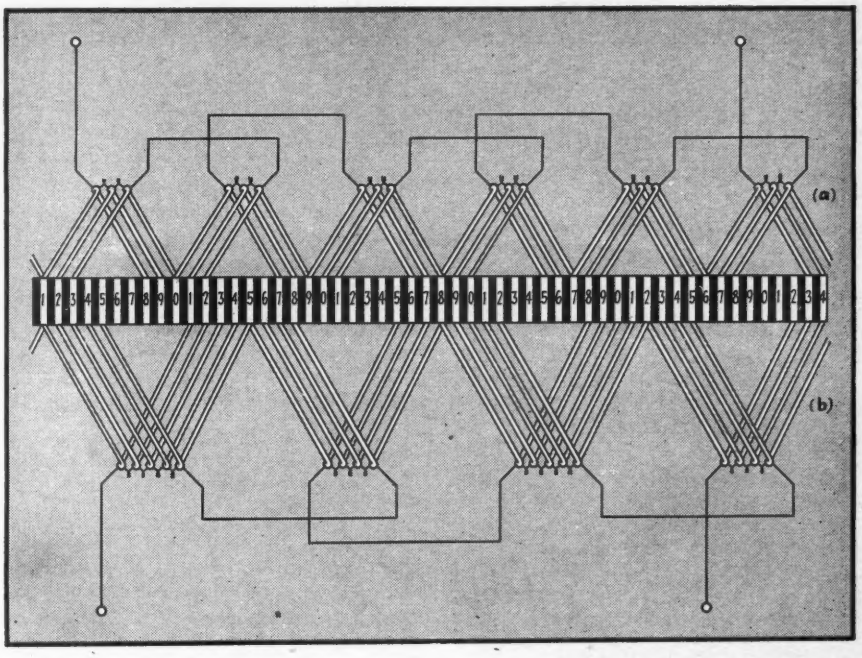


Fig. 7.—(a) A 10 hp., 1150 rpm., 208 volt, 60 cycle, three phase motor with one phase-winding shown. Stator has 54 slots and coils of 25 turns each spanning 7 slots. Connection: Series Delta. (b) Same stator rewound with unequal groupings to operate on a 208 volt, 25 cycle, three phase supply at about 725 rpm. Connection: Series, star or delta as desired.

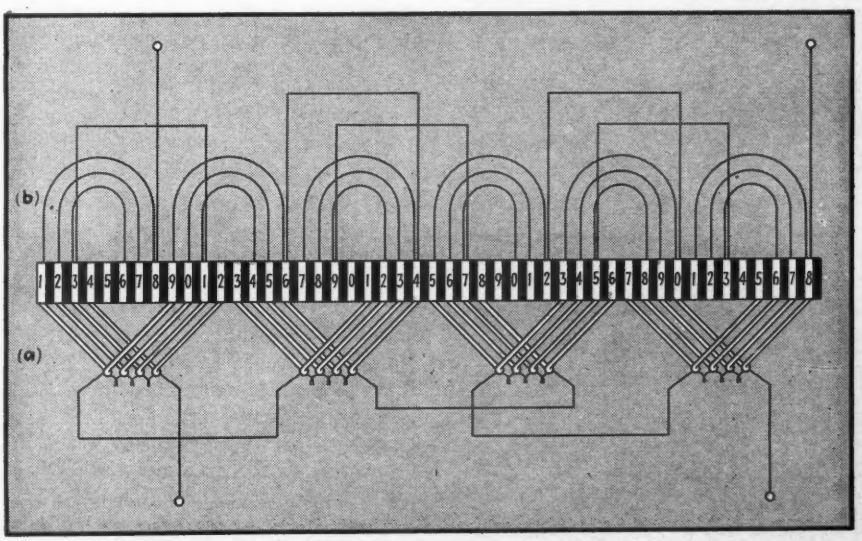


Fig. 8—(a) A three phase, 220 volt, 25 cycle, 725 rpm., series-star connected, three phase motor with 40 turns per coil and one phase-winding showing. (b) Same stator core rewound to operate on a single phase, 120 volt, 60 cycle supply. Speed: about 1150 rpm. Connection: Series.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Power Duct Supports Lighting Circuits

WIRING

Engineers at the Hall Engineering Company, prominent Detroit electrical contracting firm, are always alert to time and labor saving ideas. One of their unique designs was the mounting of lighting distribution circuits direct to the power distribution duct.

The installation, made in the new building of the Ex-Cell-O Corporation, Detroit machine tool manufacturer, embodied the use of bus duct for power and Trol-E-Duct for lighting. The 500-ft. by 600-ft. building was served by parallel runs of 500-amp., 230-volt, 3-phase, bus duct mounted on 12-ft. centers, 12 feet above the floor. Mounting bolts threaded at each end, were inserted horizontally in the wood forms—threaded ends extending through forms—before the concrete beams were poured. Upon removal of the forms, metal straps were mounted to the bolts to support the power duct at 6-foot intervals (two bolts per hangar).

FIG. 1—Close-up view of duct section showing Trol-E-Duct mounted to bus duct flange; also fixture suspension.

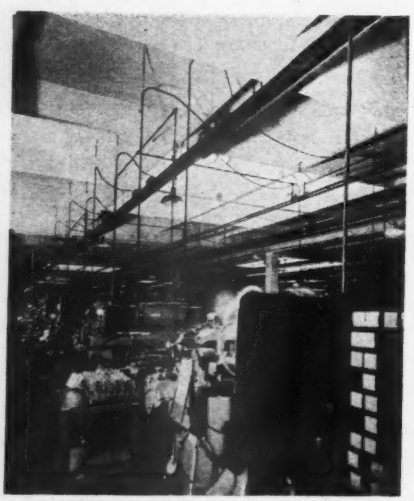


FIG. 2 — Production area showing power cable drops to motors and duct-supported lights over the machines.

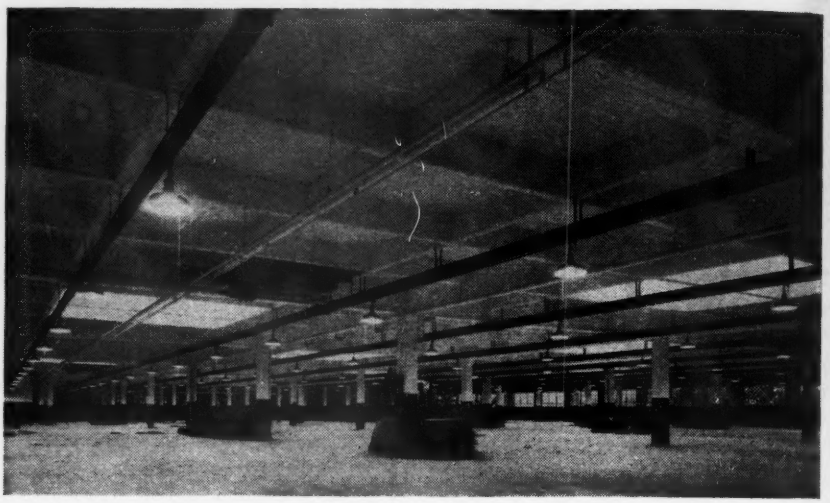


FIG. 3—Parallel runs of plug-in bus duct, on 12-ft. centers, serve the manufacturing area. Lighting circuits and fixtures are mounted direct to underside of duct.

Once the power feeders were installed, the 50-ampere Trol-E-Duct was mounted to the underside of the bus duct. In general, the assembly bolts of the power duct flange were used to fasten the Trol-E-Duct supporting clips. Incandescent, RLM fixtures were then mounted to the Trol-E-Duct on approximately 12-ft. centers and about 10 feet above the floor. Individual bracket lights were used on each production machine to provide the localized light needed for the task at hand.

Construction economics resulting from this branch circuit design are obvious. No suspension rods, brackets or messenger cable were necessary to support the lighting system and the individual fixtures were spotted over the machines under the power duct, as desired.

Maintenance Extends Power Truck Life

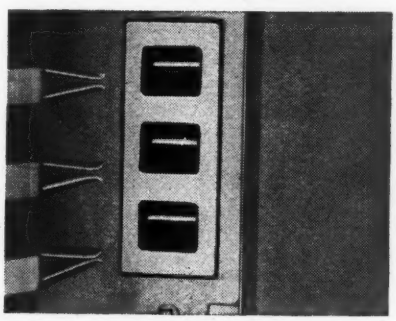
MAINTENANCE

The versatility of storage-battery-powered industrial platform trucks has been repeatedly demonstrated during the past two decades in the Pittsburgh plant of Hubbard and Company where a fleet of 13 units is speeding the production tempo of construction hardware used for street lighting, communication and power pole lines.

The uninterrupted service rendered by these trucks has permitted accelerated movement of materials, conservation of warehouse space, the handling of heavier loads in shorter intervals and the overall reduction of costs. William Riehl, chief electrician, credits this service record to the rugged construction of the equipment, the rotation of batteries and regular maintenance. Nineteen batteries are alternated between the 13 trucks so that spares are always available. Changing batteries is accomplished by means of an overhead electric hoist which lifts out the discharged unit and installs a recharged one in a few minutes.

Maintenance inspections are a weekly routine. Motors are blown out with compressed air, brushes are inspected for wear and all wiring is checked for grounds. Insulation of wires is in-

Plant managers become *Quick-change Artists* . . . with Westinghouse Bus Duct



Busbars are both supported and insulated by Westinghouse Prestite receptacles, which also serve as insulated plug-in openings.

Relocating machinery . . . adding or replacing machinery . . . becomes simple . . . and fast . . . where industrial secondary power is carried by a bus duct system. You can plug into Westinghouse Bus Duct from either side, with plug-in openings spaced at intervals of 12 inches. Possibility of phase-to-phase short is eliminated at plug-in openings by completely insulating each plug-in point with Prestite, which also supports and insulates the busbars.

Installation is easy. Wrench, screwdriver, block and tackle are the only tools required. The sliding, cantilever hanger . . . exclusive with Westinghouse Bus Duct . . . makes it unnecessary to waste time lining up fixed hangers on duct with fixed supports overhead.

Get the most efficient and economical secondary power distribution system for your plant by calling in Westinghouse Bus Duct Engineers. Ask your Westinghouse Distributor, or write for Booklet B-3714 containing latest bus duct information. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60634

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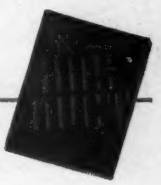
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

BUS DUCT



New Bus Duct Data Book contains complete information for developing a Bus Duct system for your plant. Ask your Westinghouse representative or write for copy.

Which of these transformer assemblies will do the best job for you?

Standard
TRADE MARK

FOR RURAL LINE SERVICE

TYPE AR

ARP with valve arrester

ARP with double gap arrester

CSP single bracket

TYPE SRO

SRO with double gap arrester

SRO with valve arrester

Any of the above can be furnished with single or double mounting brackets

Rural transformers as manufactured by The STANDARD Transformer Company are not a cut and dried proposition. Builders of a full line of rural transformers, STANDARD installs "built-on" protective devices in a wide variety of arrangements to meet your requirements. And, a choice of accessories to meet your individual operating standards and requirements is also included in alternate tank designs which have two or four mounting brackets.

The AR, ARP, and CSP types are made in capacities of 1.5 KVA and up, in all standard voltage ratings.

NEW DEVELOPMENT

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You will find upon further investigation that STANDARD'S transformers keep losses at a minimum and stimulate continuity of service. Therefore, write without further delay for bulletins S-301 and S-301-A.

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Please send Bulletin S-301-A on SRO type transformers and S-301 on AR, ARP, and CSP types.

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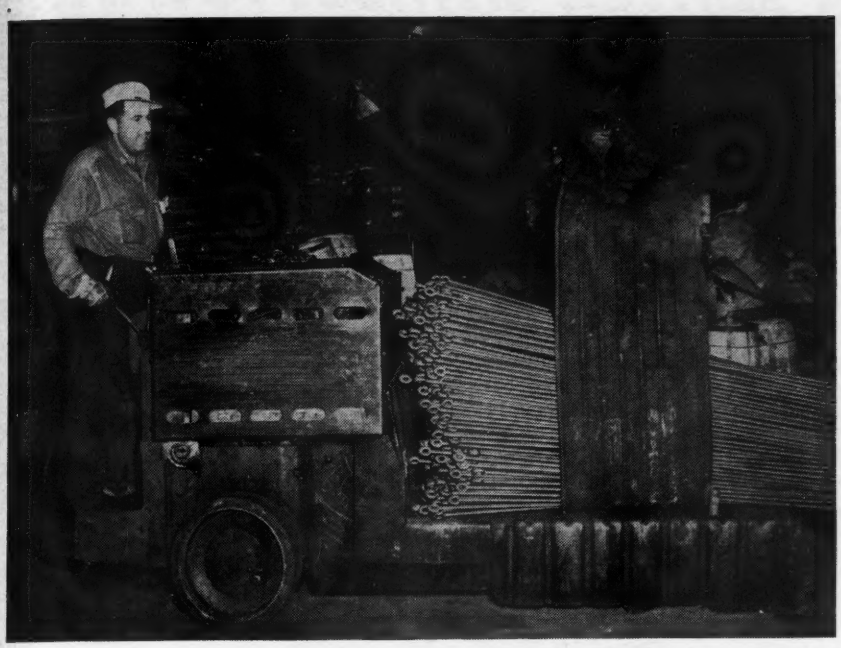
THE SPECIALISTS IN TRANSFORMER DESIGN FOR OVER 25 YEARS



One of the thirteen storage-battery-motored industrial trucks used in the Pittsburgh plant of Hubbard and Company. Nineteen batteries are rotated between the 13 trucks, periodic maintenance keeps equipment in operating condition and worn parts are promptly replaced from stock.

spected for injury or chafing and all terminal bolts tightened. Controller contact points are replaced when necessary. Greasing and lubricating is included for all moving parts and worn bearings and brushes are replaced from stock.

Incoming supplies of steel in bar, rod, plate or sheet is handled by overhead cranes but material in production and during final movement to motor truck or box car for shipping in bundles, kegs, sacks, cases, crates and cartons is moved exclusively by motorized industrial trucks.

Although the capacities of the six high lift and seven low lift trucks are between 3000 and 6000 pounds, loads of 7500 and 8000 pounds are frequently handled. The trucks are worked constantly in the rough store and press department, hot mill and forge, thread room, galvanizing section and warehouse. Constant operation and frequent overloads place severe strains on motors, batteries and trucks and their long life is an indication that proper maintenance creates liberal dividends.

Wiring Photographic Studios, Darkrooms

WIRING

As a vital requisite in modern photography, electricity is integrated with a thriving industry and America's foremost hobby. Studio and darkroom techniques are placing ever-increasing dependence on artificial lighting and electrical controls for photographic processes; a trend which is resulting in new and revamped electrical installations for both commercial firms and the amateurs.

Photography is growing constantly in popularity, scope and versatility. Recognized as a fundamental factor of advertising, publishing and decorating, it is constantly attracting more and more amateurs. Photo magazines as well as thousands of contests and salon exhibits sponsored by camera clubs, photo equipment manufacturers, travel agencies, newspapers, publicity minded industrial groups, city councils and State departments are offering valuable prizes and recognition to encourage serious photographic endeavor. Greater leisure and higher incomes also encourage the hobby so that amateur darkrooms are now common. Many corner drug stores are developing outlets while numerous apartment houses, office buildings, schools and camps have darkrooms for the convenience of tenants, students and members. Besides occupying entire buildings, professional portrait studios are located in department stores and are set up as temporary, mobile units for college and rural localities.

The strongly competitive and lucrative portrait field is placing emphasis on attractive and public-attracting modern illumination for halls, reception rooms, display cases, offices and powder rooms as well as on lights and controls in the studios, darkrooms, retouching and mounting departments.

Since many in the electrical trades are among the millions of camera devotees in the country, a check list for wiring a studio or darkroom should be of personal as well as professional interest.

CHECKLIST FOR WIRING STUDIOS AND DARKROOMS

Bath and tank heaters
Burnishers
Clocks
Contact printers
Darkroom safelights
Developing rockers
Disc stoves
Dryers
Enlarging equipment
Fans: drying, exhaust, ventilating
Film dryers
Fill-in or back-lights
Glue pots
Lamps for portraits, copying table-tops
Mount cutter
Mounting irons
Plate dryers
Print dryers
Printing machines
Radiators
Refrigerators
Signs
Spotlights
Tell-tale control lamps
Water heaters
Wax heaters

Recommended illumination in footcandles:

Halls	5 — 10
Reception rooms	10 — 20
Offices	35 — 50
Displays and powder rooms	50 — 90
Studios and darkrooms should be equipped with general illumination in addition to the special spotlights and safelights used during actual photographing and developing.	
General lighting	35 — 50

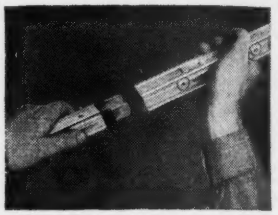
Adjustable Racks For Anodizing

INDUSTRIAL

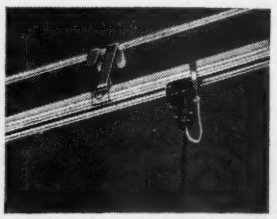
Adjustable racks for holding a wide variety of metal parts has greatly speeded the process of anodizing in the Finishing and Plating Department of the Glenn L. Martin Company, Baltimore, Maryland. The racks, designed by em-

Lights added or shifted without rewiring

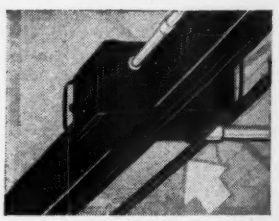
A stepladder is the only equipment necessary to add new lighting fixtures with a BullDog Universal Trol-E-Duct system. Simply insert the weight-supporting clamps in the duct casing and tighten the lock nuts with your fingers. Then insert the twist-out plug in the duct casing and give it a quarter turn.



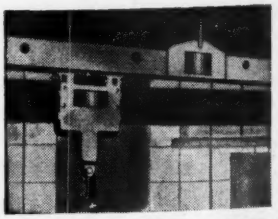
SECTIONS JOINED WITHOUT TOOLS. *Installation time cut to a minimum . . . special couplings snap into locked position automatically, hold sections together securely.*



COMPLETELY ENCLOSED FOR SAFETY. *Twistout plugs and trolleys collect current from copper bus bars safely enclosed in Universal Trol-E-Duct.*



BUSTRIBUTION DUCT FOR PLUG-IN POWER DIRECT TO MACHINE. *Machines moved without down-time for the rest of the line. A variety of circuit protective tap-off Bus Plugs for spotting and plugging in machines instantly, without rewiring.*



INDUSTRIAL TROL-E-DUCT MOVES THE POWER WITH THE TOOL OR LOAD. *Production rates go up — operating costs go down with this flexible system. Moving trolleys transmit power safely from duct bus bars to moving cranes, hoists and portable tools.*

You Can Do It With BullDog Universal Trol-E-Duct

You can have the *right light* in the *right place*—at any time and with little effort or expense. Miracle? Well, maybe just a small one. We call it Universal Trol-E-Duct.

In a plant equipped with Universal Trol-E-Duct, you can have light at the precise point where it's needed, because every inch of this continuous slotted duct is a potential electrical outlet.

You can add new lights of any type or you can move old ones. You can put small portable tools to work without long extension cords. And you can do both jobs without costly delays for rewiring.

Universal Trol-E-Duct is easily installed with prefabricated, standardized sections. Runs of duct can be altered, or completely dismantled and re-installed with complete re-use of all material.

For better production through better lighting, call a BullDog field engineer, or write for detailed descriptive folders.

BullDog also Manufactures Vacu-Break Safety Switches—SafToFuse Panelboards—Switchboards—Circuit Master Breakers—BUStribution DUCT for "plug-in" power—Industrial Trol-E-Duct for "moving" electrical loads.

BULLDOG

ELECTRICAL DISTRIBUTION SYSTEMS

BULLDOG ELECTRIC PRODUCTS COMPANY, BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN
In Canada: BullDog Electric Products, Ltd., Toronto. Field Engineering Offices in All Principal Cities

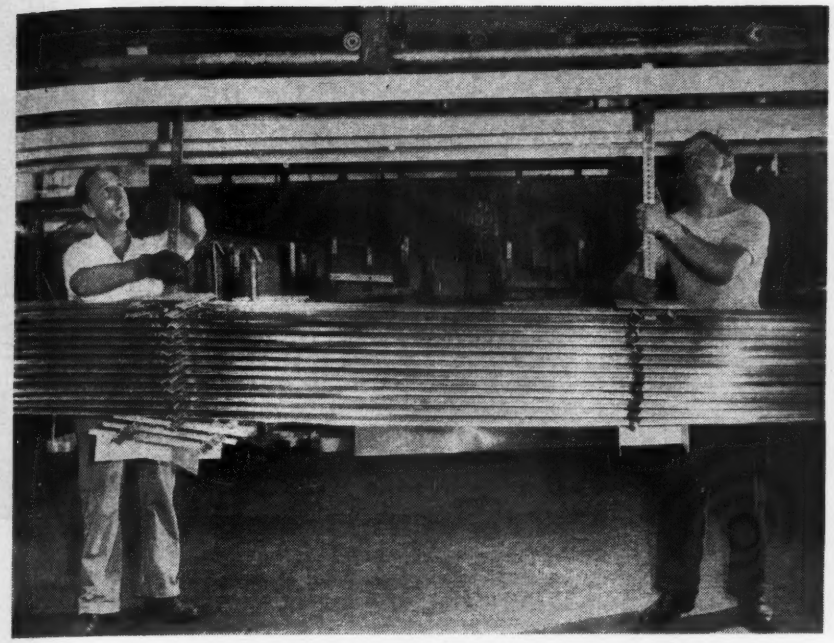


FIG. 1. An aluminum alloy center post can be used either singly or in combination for stacking metal parts prior to anodizing operation. Toothed plate on bottom prevents slipping and pressure plate at top is held by spring and pin through center post.

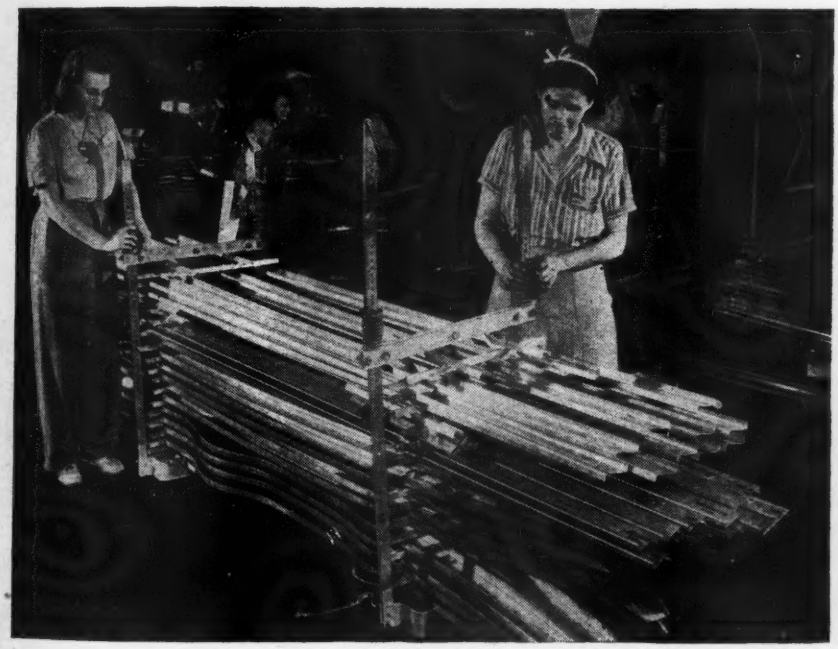


FIG. 2. Double post racks have fixed channel section at bottom and movable channel at top. Upper edges of lower section and bottom of top bars are toothed for better grip. Tops of posts are hooked to permit easy handling with overhead conveyor.

ployees in the department, are of two basic types and have been made in several sizes so that, used either singly or in combination, nearly every size and shape of metal work in the plant can be handled.

The first type of rack consists of an aluminum alloy center post with a frame at the bottom on which parts can be stacked. The parts are stacked in tiers, each layer placed at right angles to the layer below and above. If the length of the parts is such that two racks are necessary, they are stacked in one direction only (as illustrated by the picture) and spacer bars placed between each layer to properly hold the parts. The top edges of the bottom frame are toothed to keep the work from slipping A pressure plate at the top holds the racked work firmly in place, the pressure plate being adjustable for height and held in position by a spring and pin which is inserted in holes drilled in the center post. The top of the center post is in the form of a hook to permit easy handling with an overhead conveyor.

The second type of rack has two posts with a fixed channel section separating them at the bottom and a movable cross section at the top. Top edges of the lower section and bottom edges of the top section are toothed to prevent slipping. Work is loaded on the bottom section and the top clamped down to hold it in place, the same principle used in the single post racks. Where possible, small parts are used for the cross spacer bars, thus utilizing the solutions to the utmost and avoiding waste.

The racks are simple and durable, permit the anodizing process to be completed in half the former time and contribute substantial savings in electrical current consumptions. Where former spring hangers had to be cleaned after each usage the newer hangers have an indefinite limit and it is only necessary to clean the bottom frame after usage. The temper and life of the springs has also been lengthened materially.

Since the frames are of straight rigid metal construction, they are easily cleaned and unaffected by the cleaning bath. Loaded racks may be noticed in the background of Fig. 2, fully loaded with parts criss-crossed around the center poles in log cabin fashion. Far greater use of the anodizing tanks is permitted due to the orderly arrangements of the metal parts.

Individual rectifiers of the copper oxide type are used in the silver plating department of the Chrysler Corporation's Dodge-Chicago Plant. Units like this 4 kw., 440-volt (input) one with 400-amp., 6 volt output, are an integral part of each plating tank assembly.

TODAY...TOMORROW...IN THE FUTURE
WHEN YOU NEED IDEAL PRODUCTS OR SERVICE, PLEASE SEE YOUR NEAR-BY WHOLESALER

IDEAL JOBB

A PARTIAL LIST OF IDEAL PRODUCTS

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Commutator Resurfacers
Slip Ring Resurfacers
Commutator Cleaning Stones
Carbon Brush Seaters
Precision Grinders
Commutator Undercutters
Armature Air-Gap Gauges
Thermo-Grip Soldering Tools
Electric Brazing Unit
Flashlight Battery
Battery Charger
Coil Tamping Tools
Wedge Drivers
Commutator Cement
Slotting Files
Slot Scrapers
Commutator Saws
Commutator Cutters
Coil Winder Drive
Coil Winder Heads
Electric Marker
Flashlights
Mazda Lamps
Armature Winding Head
Armature & Stator Holder
Insulation Former
Adjustable Growler
Insulation Tester
Sanding Discs
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Pneumatic Nut Setter
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Pneumatic Riveting Hammer
Pneumatic Tool Accessories
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Live Centers
Balancing Ways
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Tool Room Etcher
Machine Shop Etcher
Etcher-Demagnetizer
Portable Demagnetizers
Universal Chuck
Independent Chuck
AC Magnetic Chuck
Granite Surface Plate
Grinding Wheel Dresser
Hand Type Tachometer
Panel Type Tachometer

INDUSTRIAL CLEANER DIVISION
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Water Pick-Up Cleaner
Suction Cleaning & Spraying Attachments

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Fish Tapes
Solder Lugs
Solderless Lugs
Cable Connectors
Joist Borer
Wire & Cable Reel
Fuse Clip Clamps
Fuse Reducers
Test-Glo
Test-Lite & Fuse Puller
Fuse Pullers
Hot Blade Stripper
Brush Type Wire Stripper
Rotary Type Wire Stripper
Hand Type Wire Stripper
Foot Operated Stripper
Lever Type Stripper
Bench Type Stripper
Wire Skinner & Straightener
BX Armor Cutter
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Cable & Wire Cutter

SERVING OVER 50,000 USERS

Announces
BER POLICY

To Save You Time and Money...

Today, after many years of planning and working in cooperation with Jobbers, IDEAL is happy to announce A STRICT JOBBER SALES POLICY.

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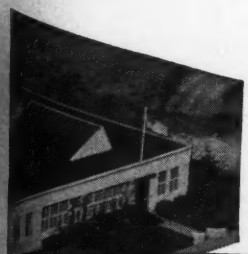
1. ***Saves Time*** because your Wholesaler is as close as your phone.
2. ***Speeds Delivery*** since shipment is made from Jobber's stock.
3. ***Gives immediate*** price and catalog information.
4. ***Offers*** sound application advice based on years of experience.
5. ***Reduces*** purchasing and accounting work.
6. ***Insures*** faster service on complaints and adjustments.
7. ***Simplifies*** establishment of credit.
8. ***Keeps you*** constantly informed of new products and developments.

Selling IDEAL products is not a new innovation with Jobbers, for many of them have been distributing IDEAL products for over 30 years. Today, as a result of this vast experience, they possess the "Know How" to help save you time and money.

Furthermore, IDEAL'S Staff of over 200 trained service engineers will continue to assist you—through your IDEAL Wholesaler—in solving your maintenance, production and construction problems.

Remember, there are over 100 IDEAL Products, each designed to handle many different jobs.

If you have been in the habit of buying direct in the past, please see your local Wholesaler today. If you will let him know of your usual IDEAL requirements, he will quickly show you why IDEAL has adopted a FULL JOBBER POLICY.



IDEAL

Distributed Through America's Leading Wholesalers

IDEAL INDUSTRIES, Inc.

(Successor to Ideal Commutator Dresser Co.)

1914 **1041 PARK AVENUE** **SYCAMORE, ILLINOIS**

"LEAD SITUATION BECOMING PROGRESSIVELY WORSE"

Lead-Covered Cable to Remain in Short Supply

According to a recent report of the Civilian Production Administration "the lead situation is becoming progressively worse . . . it is feared that the inability to obtain lead will result in curtailment of production by lead consuming industries such as the battery, chemicals and cable covering industries."

...but Okonite has time-tried answers

Among today's Okonite-introduced cable developments are, fortunately, a number that do the job of lead-covered cables as well as—and in some cases—better than those long scarce items. Here are several suggestions for removing the handicaps of today's shortages. Among them you may find more than one answer: Write for Bulletins to The Okonite Company, Passaic, N.J.

FOR LOW VOLTAGES (0-5000 volts) . . .
use OKOLITE-OKOPRENE* CABLES

Okolite-insulated conductors are protected by a sheath of Okoprene, an Okonite-designed neoprene compound. No braids to rot or disintegrate. Resist moisture, ozone, sunlight, oil, chemicals and flame. Flexible. Long-lived. Tough air-tight covering provides permanent seal. High surface resistance. Surface discharge eliminated. No lead wipes or potheads. No expert splicers needed. Recommended for apparatus leads, networks, power, light and signal circuits. Millions of feet in service. Bulletin OK-2009-E.

*U.S. Pat. No. 2,312,058

FOR HIGHER VOLTAGES (To 38,000 volts) . . .
use the same OKOLITE INSULATION WITHOUT A LEAD COVERING

with Okoprene or other finishes for direct burial or in ducts. Also for submarine cables and dredge cables, and in other completely-immersed circuits. 20-year service record. Excellent moisture, heat and ozone resistance. Low specific inductive capacity and power factor. Eliminates electrolysis. Simplifies splicing and terminating. Reduces terminating costs. Bulletin OK-2007-D.

FOR HIGH VOLTAGES (Up To 230,000 volts) . . .
use
OILOSTATIC TRANSMISSION SYSTEMS

with oil-impregnated paper-insulated conductors in welded steel pipe filled with oil under 200 lbs. pressure. Higher dielectric strength. Greater insulation stability. Increased current carrying capacity. Right of way costs radically reduced. Proved in past 14 years. Over 20 separate circuits in operation. Improves property values by eliminating overhead lines. Saves space in generating stations. Bulletin OK-2019-A.

FOR STREET AND AIRPORT LIGHTING, UNDERGROUND BUILDING ENTRANCES . . .
use HAZARD ARMORTITE CABLE

non-metallic underground cable with protective coverings of asphalted jute, leather-like armor tape, plastic sealing compound and rubber-faced tape. Not affected by moisture, acids or alkalies. Introduced in 1928, has served nearly two decades without insulation failure. Can be buried directly in ground. Mechanically strong. Requires no conduit. Bulletin 146.

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

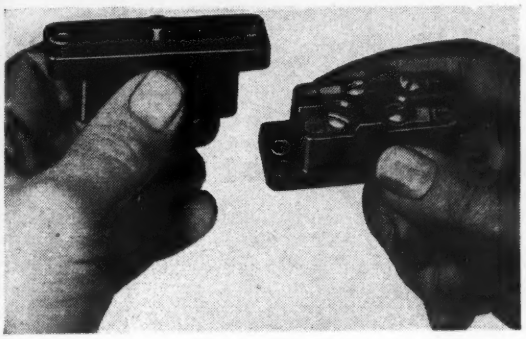
4661

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

Equipment News

Precision Snap Switch

A new precision snap switch with an unlimited number of applications has been announced. The device has a self contained mechanism for making or breaking a circuit, in small space, with short movement and light pressure. Small in size—approximately 2½-in. by 1-in. by ⅞-in.—it is claimed that this Class 9007 Type A snap switch features husky construction, unusual mounting convenience and 550 volt ratings. Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.



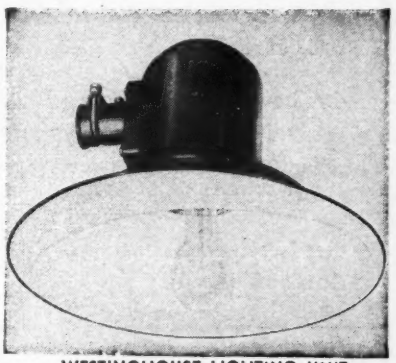
SQUARE D SWITCH

Fluorescent Lamp

New fluorescent lamps, designated as 4500° white lamps, in 40 watt T12 and 100 watt T17 sizes have been announced. These lamps are offered for many applications where lighting can be improved by using a colored light source "warmer" than standard 6500° daylight lamps and "cooler" than the standard 3500° white types. Initial ratings for the new lamps are 50 lumens per watt for the 40 watt size and 40 lumens per watt for the 100 watt size. They are interchangeable with fluorescent lamps of the same wattage ratings now used in existing fixtures. Sylvania Electric Products Inc., Salem, Mass.

SYLVANIA FLUORESCENT LAMP

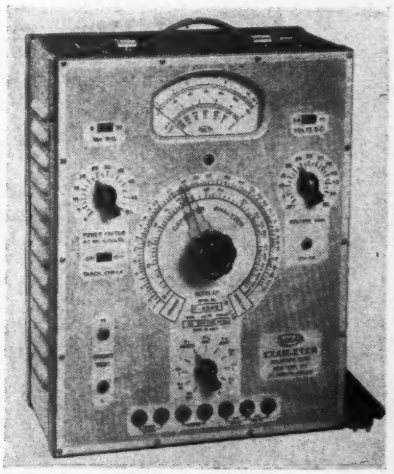
Street Lighting Unit



WESTINGHOUSE LIGHTING UNIT

An open type street lighting unit with parabolic oval contours for small street lamps has been announced. Designed so that the bottom edge of the lamp filament is approximately ¾ inches above the lower edge of the reflector, giving a cut off of 85° from the vertical, the luminaire uses either 1000 or 2500 lumen, 5⅜ inches light center lamps. The unit is supplied for mounting on 4¼ inch and 3-15/16 inch standard heel adapters, or on screw heel adapters; it replaces the radial wave reflectors on any type of hood. Unit is recommended for suburban and rural service. Westinghouse Electric Corp., Pittsburgh 30, Pa.

Capacitor Analyzer



SOLAR ANALYZER

This new capacitor analyzer, Model CF Exam-eter features a patented "Quick-Check" oscillator circuit for spotting intermittent, open-circuited and short-circuited capacitors without the necessity of unsoldering them from electrical circuits. It contains a d-c bridge to check capacitances from 10 mmf to 2000 mf and resistances from 100 ohms to 7.5 megohms. Capacitor power factors up to 55 percent are read on an auxiliary bridge scale. The 4½ inch meter used in the vacuum-tube-voltmeter bridge null indicator is also used to measure electrolytic capacitor leakage currents under rated voltage from a self contained continuously adjustable d-c voltage supply. Extra test jacks permit overload proof external vacuum tube voltmeter measurements up to 600 volts d-c and 50 volts a-c. An electronic test circuit supplements the bridge for measurements of capacitor insulation resistance up to 10,000 megohms. Solar Manufacturing Corporation, 285 Madison Avenue, New York 17, N. Y.

New answers to your questions about

Certified Ballasts

In our last two ads, we said...

1. Certified Ballasts are built to exacting specifications.
2. They're Certified as meeting the specifications by Electrical Testing Laboratories, Inc.
3. They assure good lamp performance—good fixture operation.
4. They're built for long life, no excessive heating; they're quiet—and they *cost no* more than other ballasts.

Get Certified Ballasts for protection and service!

Certified Ballasts "Cover the Waterfront"

Q. Do all the advantages offered by Certified Ballasts apply to all types of fluorescent lighting applications?

A. Yes. Besides standard fluorescent tubes, testing and certification of ballasts applies to slimline fluorescent tubes and to circular fluorescent for portable lamps.

Q. What about portable lamps for home use?

A. The use of Certified Ballasts in home lighting equipment is VITALLY IMPORTANT. For example, Certified Ballasts properly installed can prevent heat and noise that would make an otherwise good portable lamp a liability and a nuisance.

Q. How will the user recognize the difference between a Certified and non-Certified ballast?

A. He may not recognize the difference unless *you* make a distinct selling point of Certified equipment . . . and clearly explain the advantages. It pays to emphasize *protection* . . . with Certified Ballasts.

Q. What lighting equipment manufacturers now use Certified Ballasts?

A. Certified Ballasts are used in Certified Fleur-O-Lier fixtures, Reflector Lighting Manufacturers (RLM), Certified Lamp Makers (portable lamps), and hundreds of individual manufacturers.

The Certified Ballast program is open to all manufacturers who comply with the engineering specifications.

Certified Ballast Manufacturers

Makers of Certified Ballasts for Fluorescent Lighting Fixtures

The Acme Electric & Mfg. Co.
Cuba, New York

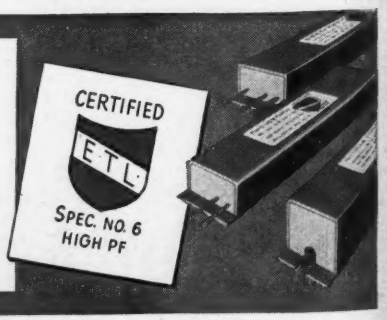
Chicago Transformer Div.
Essex Wire Corporation
3501 Addison St., Chicago, Illinois

General Electric Co.
Specialty Transformer Division
Fort Wayne, Ind.

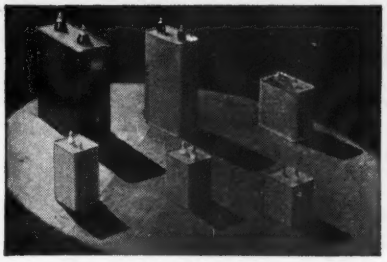
Jefferson Electric Co.
Bellwood, Illinois

Sola Electric Co.
2525 Clybourn Avenue
Chicago 14, Illinois

Wheeler Insulated Wire Co.
378 Washington Ave., Bridgeport, Conn.



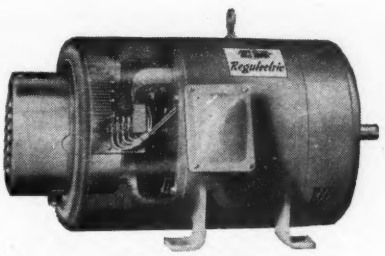
Pyranol Capacitor



G-E CAPACITOR

Development of a complete new line of small, lightweight, d-c Pyranol capacitors for use in flash-photography apparatus, light metal welders, and similar applications requiring economical energy storage, fast discharge and overall reliability has been announced. Available in a wide range of ratings, with ambient temperature operating limits at rated voltage ranging from 0 to 50 degrees C and capacitance tolerances at 25 degrees plus or minus ten percent, it is claimed that these units meet practically every requirement of high speed or stroboscopic photography as well as home and industrial welders. General Electric Company, Schenectady, N. Y.

A-C Generator

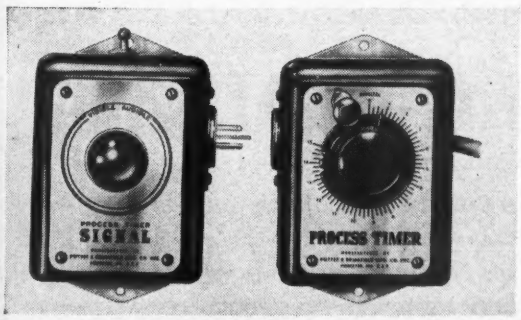


E-M GENERATOR

The principle of electrical resonance holds voltage constant in the new "Regulectric" a-c generator developed for use in engine generator sets. The generator is of the revolving field type, and is built in ratings of 5 and 7½ kw., 60 cycle, single phase; 7½ and 10 kw., 60 cycle three phase; 1200 rpm. Also in 1800 rpm. in 7½ and 10 kw., 60 cycle, single phase; 10 and 15 kw., 60 cycle, three phase. Non-moving electrical components of the voltage regulating circuit are built into the unit. Only connections required on the job for non-parallel operation are the leads from the generator to the load through the generator switch. Electric Machinery Mfg. Company, Minneapolis 13, Minn.

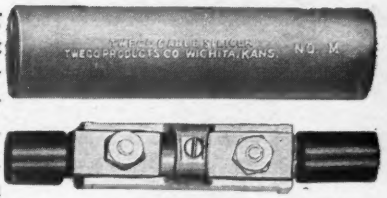
Timer and Signal Indicator

Type TA synchronous utility process timer is applicable to molding, electronic heating, plating, photography, chemical processing, heat treating, cooking, baking, drying, aging, etc. It is powered with an instantaneous starting synchronous motor that actuates a pair of heavy silver contacts rated at 1000 watts or 1 hp. load. A single three way outlet mounted on the side of the case permits connection to the load for "on during cycle" or "off during cycle and come on at end of cycle". The dial is fitted with an adjustable mechanism, so that any desired time interval up to the limit of the unit may be preset and thereafter the same time cycle will be repeated at each manual resetting, or the stop may be released and the desired interval set each time by the graduations on the dial. A companion piece to the timer is the Type A signal indicator. It contains both a buzzer and bright bullseye light. Indicator can be mounted in any position, and is fitted with a male three-way plug which will connect directly into the socket on the TA timer, or it may be remotely located at any distance by use of a three wire cord. Potter & Brumfield Sales Co., Dept. 204, 549 West Washington Blvd., Chicago 6, Ill.



POTTER & BRUMFIELD TIMER

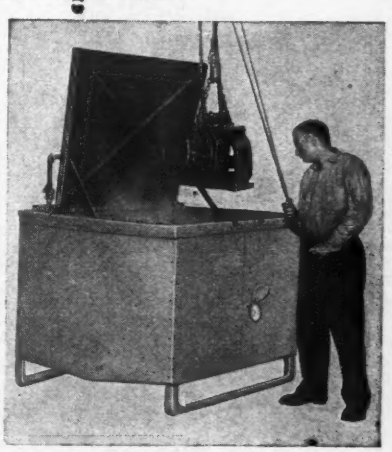
Welding Cable Splicer



TWECO CABLE SPLICER

A new line of welding cable splicers has just been announced. They provide a quick repair of broken cables or salvaging short lengths. A clamp cable connection on each end of the splicer, with provision to solder between the cable ends, assures an efficient connection, it is claimed. A fibre sleeve covers this cable splicer. It is available in three sizes—size "S" for small No. 4, 2 or 1 cables; size "M" for medium No. 1/0 or 2/0 cables; size "L" for large 3/0 and 4/0 cables. Tweco Products Company, Wichita 7, Kansas.

Motor Block Cleaning Tanks



AEROIL CLEANING TANK

Two models of motor block cleaning tanks specifically designed for the degreasing of diesel motors, truck, tractor and similar larger motor blocks are used in connection with a hot dip alkali cleaning process. The cleaning units are fully insulated and heated from the inside by means of a patented removable immersion tube system with the burner in a burner well within the fully insulated tank. Savings of 50 percent in time, labor and fuel as compared with ordinary bottom fired heating units are claimed by the manufacturer. Standard equipment includes built-in dial thermometer, heavy duty removable grilles, scum gutter, sludge drain, draw-off cock, and double braces hinged covers. Regulation may be had from 100 degrees to 550 degrees F. The equipment may be heated by either city or natural gas, liquified petroleum gas or kerosene. Thermostatically controlled equipment is operated from any lighting circuit. Model 25T has a normal dipping capacity of 270 gallons while 34T has a dipping capacity of 355 gallons. The smaller tank is 34 by 38 by 30 inches and is constructed of 14 gauge steel. The larger is 38 by 36 by 60 inches. Aeroil Products Co., 5701 Park Ave., West New York, New Jersey.

Just Say...

CENTRAL RIGID STEEL CONDUIT

...when you call your distributor and you'll be sure of getting quality that can't be beat.

"There's Tested Strength in Every Length"

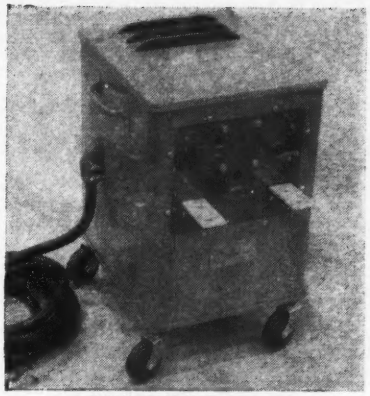
SPANG-CHALFANT

Division of The National Supply Company

General Sales Office: Grant Building, Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

Portable Brazer

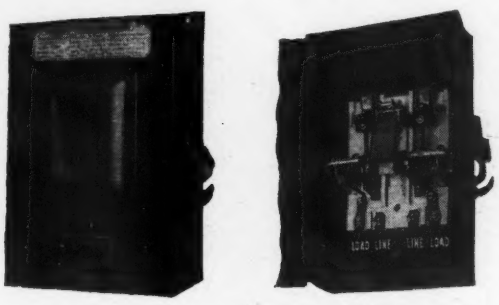


WESTINGHOUSE BRAZER

A new portable 10 kva. brazer with air-cooled tongs has been announced for general brazing service in joining copper or copper alloy parts. The new single phase, 60 cycle unit is provided with four large caster-type wheels and two handles for moving or carrying any place in the shop or yard. It requires only connection to a 220 or 440 volt source. Alternating current from an adjustable voltage transformer passes through the tongs and parts to be brazed. The transformer with line contactor is enclosed in a sheet metal case, and a clamp type entrance bushing is provided for the incoming primary cable. Built into the front of the brazer, the control panel contains outlets for brazing tong cables, receptacle for foot switch pilot cable, and voltage tap changing plug. The two pronged plug-in switch changes brazing voltage to 12, 10 or 8 volts. Westinghouse Electric Corp., Pittsburgh 30, Pa.

Automatic Switch

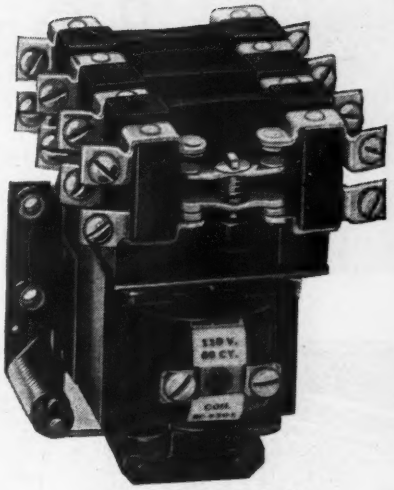
No fuses or protective devices are necessary with the new switch which automatically shuts off the current and drops the handle to the "off" position when short circuits or overloads occur. Patented overload feature up to 5000 amps. eliminates the use of fuses and the units are listed by the National Bureau of Fire Underwriters. After a short circuit has been detected and the trouble located and removed, service may be resumed by pushing the operating lever back up to the "on" position. The switches, set at the factory, have their ratings plainly stamped on the name plates outside the switch boxes. Vital parts are protected by sealed covers. No two pieces of steel rub together since all bearings are either brass or bronze. Steel parts are covered with heavy coatings of cadmium plate which protects the steel against corrosion and rust. Code Electric Products Corp., 1512 Fox Bldg., Philadelphia 3, Pa.



LEWIS SWITCHBREAKER

Solenoid Relay

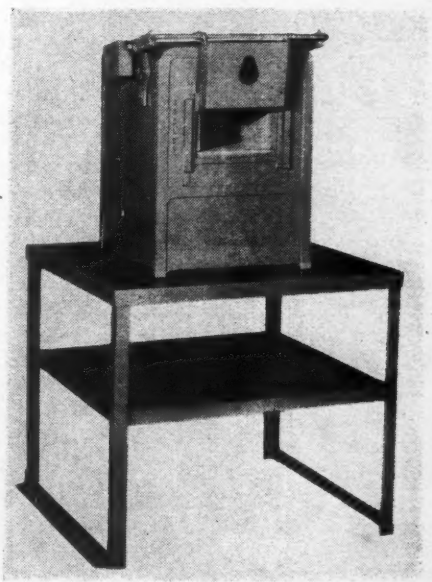
A new line of universal type solenoid relays in addition to the regular Bulletin 700 line, has been developed. A simple shift of connections makes it possible to change a set of normally open contacts to normally closed operation, or vice versa. Relays are available in 2, 4, 6 and 8 pole. They have a maximum current rating of 10 amperes, noninductive, and can be obtained for operation on 25, 30, 40, 50, and 60 cycles with voltages of 6, 12, 24, 32, 64, 110, 220, 440, 550 and 600.



ALLEN-BRADLEY RELAY

Relays are obtainable in either the open style or mounted in an enclosure. Double break, silver alloy contacts are used. The universal type should be used for switching circuits of life polarity and cannot be used as reversing switches. Allen-Bradley Company, 1311 S. First St., Milwaukee 4, Wis.

Heat Treating Furnaces



COOLEY FURNACE

Two small electrical furnaces are available for such industrial uses as heat treating tools, dies and small parts, laboratory testing, drawing, tempering, normalizing, preheating for high-speed hardening, emergency repairs and experimental testing to establish heat treating procedures. The units, measuring 8 by 6 by 14 inches and 10 by 6 by 18 inches, are designed for continuous operation at 1750 degrees F. or intermittent operation at 1850 degrees F. Approximately an hour is required to obtain the 1850 degrees temperature. The outer shell is of heavy gauge sheet steel, well insulated, and with cast iron end frames. Elements are embedded to protect them against atmospheric attack. Interlocking, rectangular elements form the interior of the chamber, and heating element replacement is simple. The furnaces may be obtained with either a counterweighted vertically operating door or a bottom hinged door which opens to form a loading shelf. A heavy gauge structural steel stand of welded construction serves as a bench for the furnace and provides a shelf for storage space beneath an ample table top area. When placed on the table, the hearth is 42 inches above the floor. The furnaces are usually operated with an indicating controlling pyrometer. Cramer-Krasselt Co., Milwaukee 2, Wis.

Benjamin's 45th Anniversary Brings You Further Assurance

A New Benjamin Product Development and Testing Laboratory is dedicated to the advancement of the art and science of illumination so that you may have ever greater assurance that YOU LIGHT RIGHT, WHEN YOU LIGHT WITH BENJAMIN.

Forty-five years ago, Benjamin began with a pioneering idea that had for its objective a better utilization of the electric lamp.

That idea, the Benjamin wireless cluster, was good enough to revolutionize the then infant lighting industry . . . good enough still to have practical application in World War II.

Today, on the occasion of our 45th anniversary, we dedicate another in the long line of pioneering steps . . . a new Product Development and Testing Laboratory.

Its purpose is to further advance the assurance that "you light right when you light with Benjamin". Through the years, painstaking engineering, and insistence on quality have assured users that they *light right* with Benjamin . . . light right from a standpoint of *light output efficiency* . . . light right from the standpoint of *correctly designed units* for the seeing task . . . light right from the standpoint of *minimization of glare* . . . light right from the standpoint of *durability*, *dependability* and *minimum maintenance cost.*

Through unyielding insistence on highest mechanical standards Benjamin units have become known as "the lighting equipment that's built like a battleship". It shall be the purpose of this new Laboratory to maintain and enhance this reputation . . . to raise quality standards . . . to give the purchaser greater value . . . in a word, to give ever increasing assurance that "*You Light Right when you Light with Benjamin.*" Benjamin Electric Mfg. Co., Des Plaines, Illinois.

BENJAMIN TRADE MARK

Lighting Equipment

Distributed Exclusively through Electrical Wholesalers

1904

Copyright 1946 by Benjamin Electric Mfg. Co.

th ANNIVERSARY YEAR

How to Reverse and Change Speed of Electric Motors

NORMALLY a motor is put to work at a given job, and it never does anything else during its useful life. But occasionally a system must be rearranged. Maybe all the motors can be put back to work on different jobs, and maybe they can't. Aside from horsepower ratings and torque characteristics, two things that determine a motor's versatility are its amenability to (1) a change in direction of rotation and (2) operation at speeds other than its rated speed.

With d-c motors reversal and speed changing is fairly easy, but all sorts of systems have been devised to accomplish the same results with a-c motors. Special variable-speed drives such as the Kramer, Roseman, Scherbius, Schrage, thyratron motor, double-induction-regulator-controlled motor are examples. There are many others, all using some special method of a-c commutation. Since most of them are pretty complex, and have rather limited application, they are not considered here. The circuits and suggestions apply only to the more common motors, and do not include special a-c commutator motors and switches or controllers that might be used.

No general statement can be made regarding the range of speed control. The output of a high-speed motor may be limited by safe temperature rise, poor commutation, or by available torque. At low speed, output usually is limited by safe temperature rise.

Change in speed with increase in load is termed "regulation", and is defined as:

$$\text{Regulation} = \frac{\text{No load speed} - \text{full load speed}}{\text{full load speed}}$$

Motors are often made suitable for operation on either of two voltages. This is done by dividing the winding into two parts and connecting them in parallel for low voltage and in series for high voltage. This means that the motor has more leads than these diagrams show. However, the procedure for speed control or reversing is not altered, and the sketches apply, assuming the connection for one or the other of the voltages to be made in the conduit box, and the leads brought out then correspond to those shown. Three-phase, multiphase induction motors may have 6, 7, 12, or 14 leads, and are usually for a single voltage only. By making accurate resistance measurements between leads it is possible to establish correct connections in case connection plate or lead tags become lost.

The National Electrical Manufacturers' Association, (NEMA) has agreed upon standard terminal markings for all commercial power apparatus, using the capital T with arabic subscript, such as T_1, T_2. All modern machines use NEMA standard markings. Many older machines, however, do not have NEMA markings; or markings may have been lost or obliterated. Therefore, to avoid confusion, the leads from the windings are labeled A, B, C, etc.

D-C Motors

Shunt Motors

To reverse: Reverse the armature circuit including interpoles, with respect to the field.

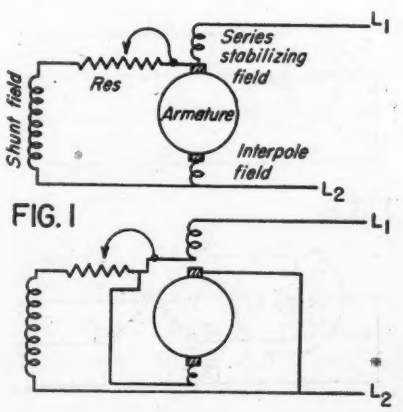


FIG. 1

Speed control: Variable resistance in series with the field. Efficient. Adjustable-constant. Small regulation.

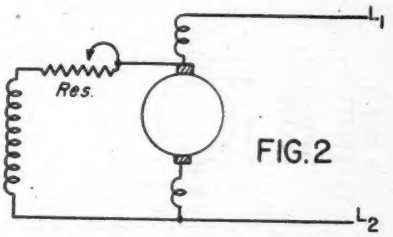


FIG. 2

Usually a shunt motor has a weak series field on the same pole piece as the shunt field. Without this weak series field some motors may actually speed up under load, because of damagnetizing armature reaction.

Series Motors, D-C or A-C

To reverse: Reverse the armature circuit including interpoles, with respect to the field.

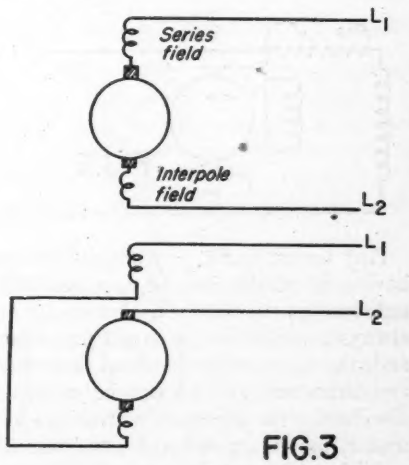


FIG. 3

Speed control: Changing armature voltage by means of autotransformer or series resistance. Autotransformer method is efficient but is suitable only for a-c. Series resistance can be used with either a-c or d-c but is not efficient. Control is adjustable varying. Very large regulation.

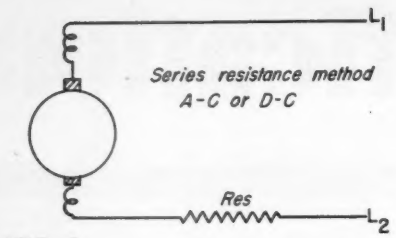
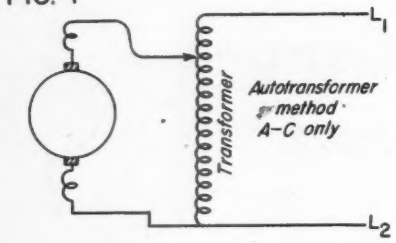
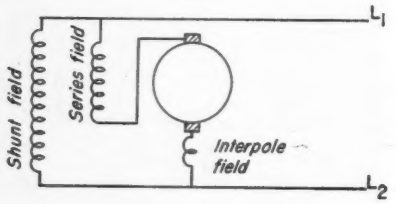


FIG. 4



Compound Motors

To reverse: Reverse armature circuit including interpoles, with respect to field circuit.



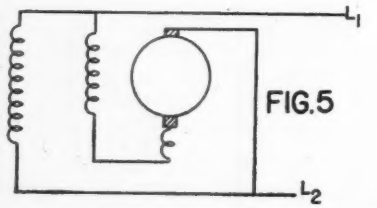


FIG.5

Speed control: Variable resistance in series with shunt field. Efficient. Adjustable-varying. Medium regulation.

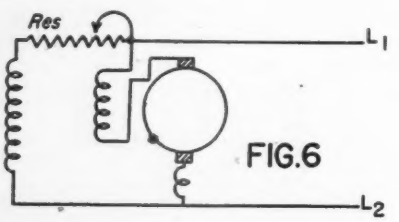


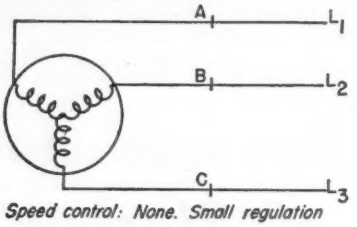
FIG.6

Any series, shunt, or compound motor having interpoles may be reversed without shifting the brushes. Interpoles are always included in the armature circuit, and the connection between interpoles and armature should not be reversed. To change the direction of rotation of a motor, the interpoles and armature are considered as a unit, and the direction of current flow through them with respect to the field must be reversed. This simple principle applies to all d-c machines and to series-wound-a-c machines. A few small machines are without interpoles, and these will commutate better if their brushes are shifted when rotation is reversed.

A-C Polyphase Motors

Squirrel-cage induction (3-phase, single-speed)

To reverse: Interchange any two line wires to the motor.



Speed control: None. Small regulation

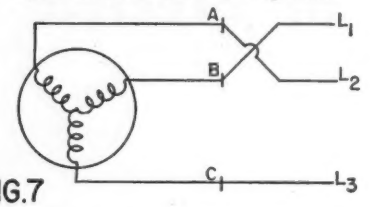


FIG.7

Squirrel-cage induction (3-phase, multi-speed)

To reverse: Interchange any two line wires to the motor.

Speed control: By connecting stator leads in various ways to obtain different numbers of poles. Necessary connections are usually shown on a connection plate attached to the motor. May be 2, 3, or 4 different running speeds. Adjustable-constant. Efficient. Small regulation.

Squirrel-cage induction (2-phase, four-wire, single-speed)

To reverse: Reverse the leads going to either one of the two phases. If both phases are reversed, the motor will run in the same direction.

If lead tags are lost, leads belonging to the same phase may be identified by using a dry cell, since there is, as a rule, no electrical connection between the two phases.

Line voltages on a 440-volt system should be:

$L_1 - L_2$	440
$L_3 - L_4$	440
$L_1 - L_3$	312
$L_2 - L_4$	312

$L_1 - L_3$ and $L_2 - L_4$ will be zero if

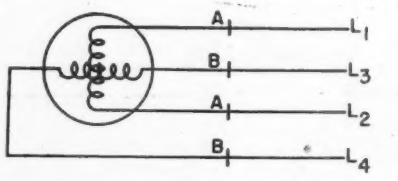
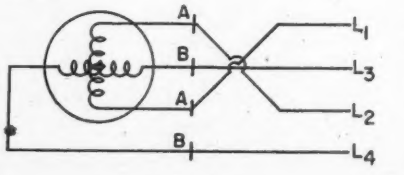


FIG.8



phases 'A' and 'B' of the supply system do not have their midpoints joined together.

Speed control: None. Small regulation.

Squirrel-cage induction (2-phase, four-wire system, multispeed)

To reverse: Same as for two phase, four-wire, single-speed motors.

Speed control: Same as for two-phase, four-wire, single-speed motors.

Squirrel-cage induction (2-phase, 3-wire system, single-speed)

To reverse: Reverse the two outside wires. The middle (called the common, or neutral) wire is not changed.

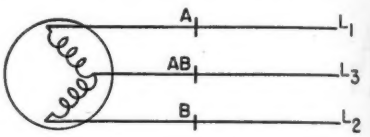
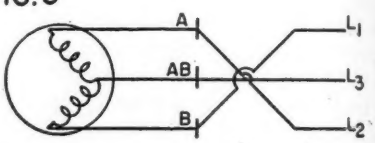


FIG.9



If lead tags are lost the common wire can sometimes be located by visual inspection, being larger, since it carries 40 percent more current than either of the others. If they are all the same size, it may be located by measuring terminal-to-terminal resistances. The resistance between the two outside leads will be twice that between either of the outside leads and the common. On a 440-volt system line voltage will be:

$L_1 - L_2$	624
$L_1 - L_3$	440
$L_2 - L_3$	440

Speed control: None. Small regulation.

Squirrel-cage induction (2-phase, 3-wire, multispeed)

To reverse: Same as for a two-phase, three-wire single-speed motor.

Speed control: Same as for a single-speed motor.

The 3-phase induction motor is more widely used than any other type. Two-phase systems are not in very general use, and most of these are 4-wire. Any 4-wire, 2-phase machine may be used on a 3-wire, 2-phase system of the same voltage by connecting the phases together at one end and using this for the common lead.

The general-purpose induction motor has a regulation of the order of from 2 to 4 percent. However, induction motors designed for hoist or punch-press duty may have regulations anywhere from 5 to 20 percent.

Totally enclosed fan-cooled motors of

2500 rpm. or above may have their external centrifugal blowers designed to work only in one direction. A motor of this type will not carry its full load without overheating when reversed. Another blower for opposite direction of rotation should be secured from the motor manufacturer. One way to tell whether a motor has a unidirectional blower is to reverse it and note the air being blown through the external ducts.

Synchronous Induction Motors

A synchronous induction motor is an induction motor with asymmetrical squirrel-cage rotor. It comes up to speed as an induction motor, locks into synchronism, and runs as a reluctance motor.

To reverse: Accomplished in same way as for ordinary squirrel-cage motors.

Speed control: None, unless stator has multipolar winding, when the speeds are selected the same as for an ordinary induction motor. This rotor has zero regulation.

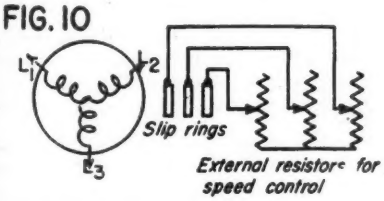
These motors are rarely used above 1 horsepower, because of poor performance, and large size for given output. They are about three times as large as ordinary induction motors of the same rating.

Wound-rotor induction

To reverse: Same as for squirrel cage. Rotor leads are not changed.

Speed control: Adding variable external resistance to the rotor circuit.

FIG. 10



Speed may be varied from near synchronous down to zero by adding more and more resistance. Operation at low speeds may be unstable unless sufficient resistance is added. Since power is wasted in the rotor resistors, speed control is inefficient, particularly for large reductions in speed below synchronous. The regulation is small for low values of resistance and increases as the resistance is increased. It is only very rarely that wound rotor motors are designed for more than one number of poles. At any speed the output is limited by safe temperature rise. They are commonly designed to deliver shaft horsepower proportional to their speed down to half speed. Below half speed, poor ventilation further reduces safe output.

Synchronous

To reverse: Same as for squirrel cage machines. The field circuit is not changed.

Speed control: None. Zero regulation.

Any polyphase motor may be reversed by reversing the phase sequence of the primary (stator) winding. This is the one fundamental principle involved, and is true without exception on all polyphase motors.

Single-Phase Motors

Capacitor-start, capacitor-run (one-value capacitor)

To reverse: Reverse the capacitor winding with respect to the main winding.

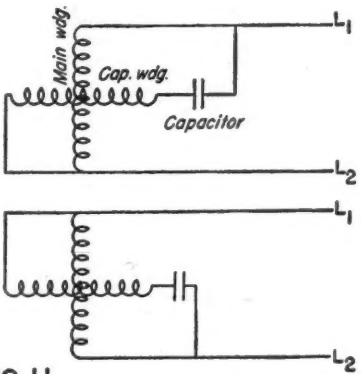


FIG. 11

Speed control: None. Small regulation.

Capacitor-start, capacitor-run (two-value capacitor)

A different value of capacitance used for starting in order to improve performance.

To reverse: Same as for single-value capacitor motor. Numerous types of controls are used to change the capacitor value from start to run. To reverse, it is not necessary to touch the control but only necessary to reverse the leads of the capacitor winding with respect to the main winding.

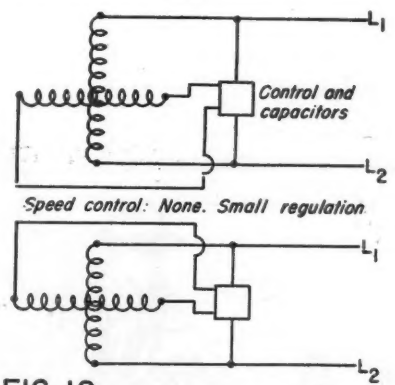


FIG. 12

Capacitor-start, induction-run

To reverse: Reverse the capacitor winding with respect to the main winding.

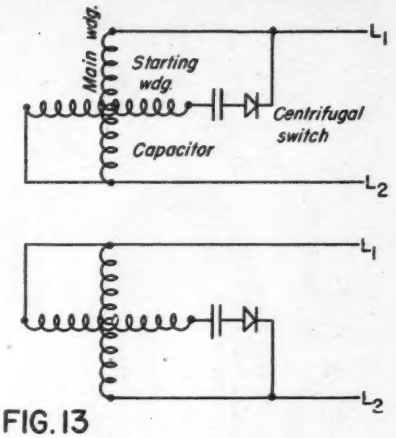


FIG. 13

Speed control: None. Small regulation.

Split-phase

To reverse: Reverse the split-phase winding with respect to the main winding.

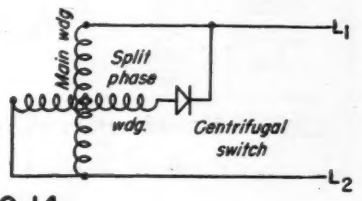
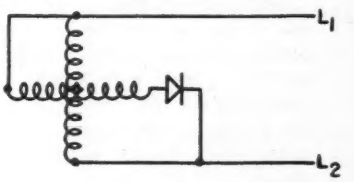


FIG. 14



Speed control: None. Small regulation. This method of starting is rarely used on motors above ¼ horsepower.

Single-Phase Squirrel-cage synchronous

Found only in small sizes. Normally started split-phase or with capacitor.

To reverse: Reverse the split-phase or capacitor winding with respect to the main winding.

Speed control: None. Zero regulation.

Shaded Pole

Used only for small fans, etc.

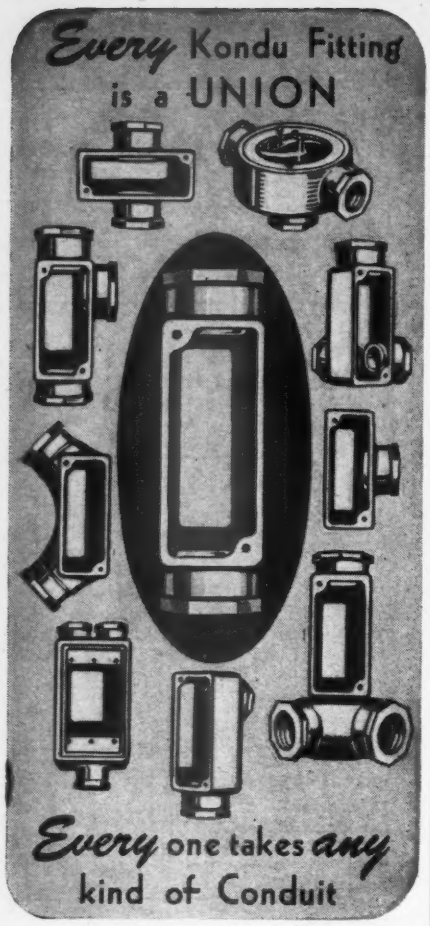
To reverse: Can be accomplished only by removing the rotor and putting it back in with the shaft sticking out the other end of the frame, or by turning the frame around with respect to the rotor. These two methods give the same result electrically.

Speed control: None. Small regulation.

Straight Repulsion

Not normally used above 1 horsepower.

To reverse: Shift the brushes to the opposite side of hard neutral. Perform-



Only with Kondu can you take one fitting out of the line and put in another, without disturbing conduit . . **only with Kondu** can you put up a conduit line before the fittings are delivered . . . because *every Kondu Fitting is a union.*

Only with Kondu can you use either standard conduit or thin-wall tubing, at any outlet of any fitting. Just slip out one bushing and slip in another . . . no extra pieces are needed.

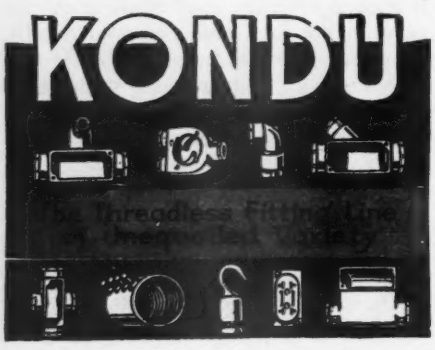
Kondu fittings hold permanently tight . . . are vibration-proof. Practically unbreakable . . . 100% re-usable. Self aligning. Roomy enough for all splices.

Write for the Kondu Catalog.

KONDU CORPORATION

Erie, Pa.

KONDU MFG. CO., LTD., Preston, Ontario



ance will be the same in either direction. Speed torque curve is symmetrical about neutral.

Definition of neutral points: Assume voltage applied to stator terminals. Shift brushes slowly around the commutator. For every pair of poles there are four brush positions which give no torque. There are two "soft" and two "hard" neutral positions. The motor draws only a magnetizing current with brushes in soft neutral position. Shifting the brushes in either direction causes the torque to increase gradually. With the brushes in the hard neutral position the motor will buzz and vibrate loudly while drawing considerable current. Torque increases rapidly with brush shift in either direction. Torque is clockwise for counter-clockwise brush shift, and vice versa.

Speed control: By brush shifting. Maximum speed is obtained with the brushes just a few degrees off hard neutral. Shifting the brushes toward soft neutral from this position causes a drop in speed. Adjustable varying. Efficient, Large regulation.

Repulsion-induction

Not often built in ratings larger than 5 horsepower.

To reverse: Reversed in the same manner as the straight repulsion motor.

Speed control: Not a good variable-speed motor. Speed may be varied to some extent by brush shifting. Speed control is inefficient. Medium regulation.

Repulsion-induction (electrically reversible type)

To reverse: Change stator connections. Lead tags and connection plates are always supplied and should indicate the proper connections.

This motor is similar to the repulsion motor except that it has, in effect, two stator windings; and the brushes are set half way between the hard neutrals of the two windings. Consequently, when power is supplied to one winding the motor runs in one direction, and when power is supplied to the other winding the motor runs in the opposite direction. In practice, the motors are wound with three windings, a main winding and two shifter windings. A single-voltage motor has six leads. The main winding and one shifter are used for clockwise rotation, and the main and other shifter winding are used for counter-clockwise rotation.

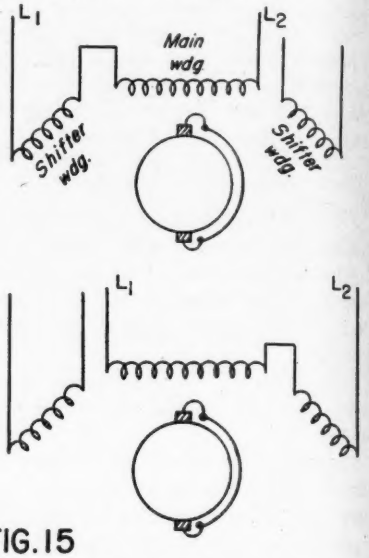


FIG. 15

If identifying markings are lost, the main winding may be found by measuring the d-c resistances of the three windings. If they are all the same, set the brushes at any one of the hard neutrals and call the corresponding winding the main winding. If the resistances are not all the same, the odd one will be the main winding. The two shifter windings should both have the same resistances. The brushes should be set at the hard neutral of the main winding for electrically reversible operation.

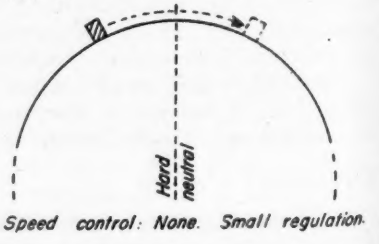
Speed control: Not suitable for variable-speed operation. Speed may be changed by brush shifting but motor should not then be electrically reversed, since correct operation in both directions can only be obtained with the brushes on the hard neutral of the main winding. This motor has medium regulation if rotor has a buried squirrel-cage winding, and large regulation if it has only a straight repulsion winding on the rotor.

Repulsion-start, induction-run

Often used for single-phase motor of ¼ horsepower or larger.

To reverse: Set the brushes on the other side of hard neutral, the same as for a straight repulsion motor. Position for best starting torque may readily be found by trial and error.

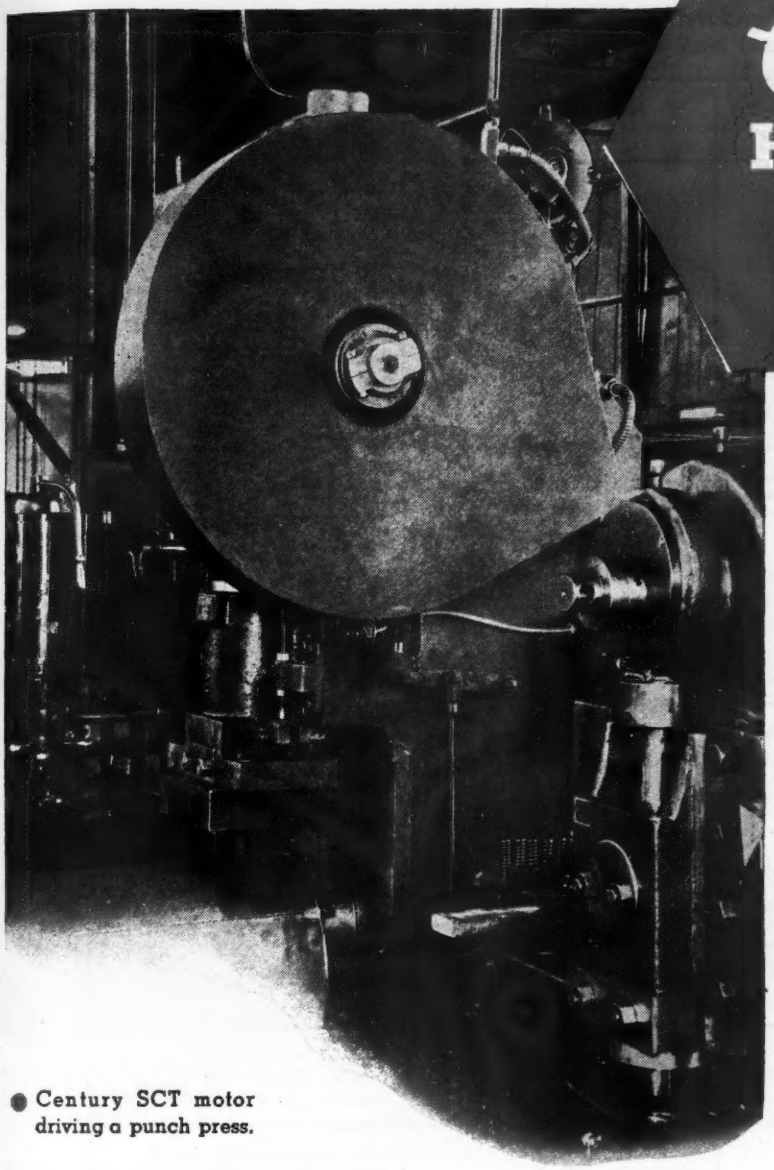
FIG. 16



Speed control: None. Small regulation.

Save Power on Punch Press and Shearing Applications with

Century High Torque, High Slip Motors

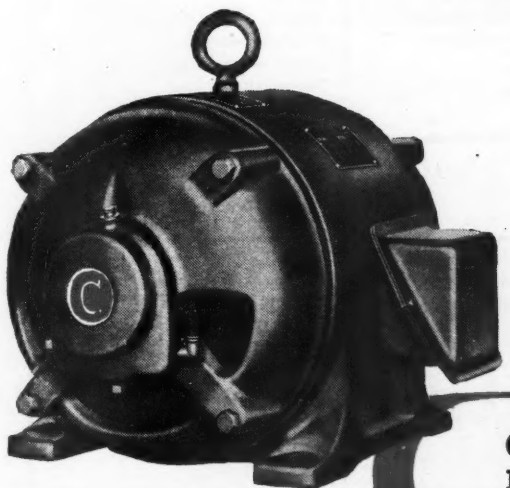


● Century SCT motor driving a punch press.

Century high torque, high slip (type SCT) motors cushion the shock of the peak of high impact loads. As the machine reaches the peak of the operating cycle, the motor speed pulls down and the machine absorbs energy stored in the flywheel. Then the motor speeds up again, storing energy for the next cycle.

Century high torque, high slip motors are particularly adaptable to applications where the length of the cycle allows time for speeding up and slowing down.

The use of the high slip motor on such applications results in smoothing out the load curve and saving wear and tear on mechanical transmission equipment.



Specify Century motors on all your electrically powered equipment. Engineered to the functional characteristics of the machines they drive to assure top performance — Century motors are a vital factor in producing a better product at a lower cost. They are built in a wide range of types and sizes from 1/20 to 600 horsepower.

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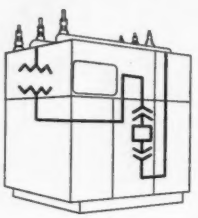
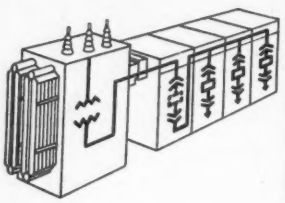
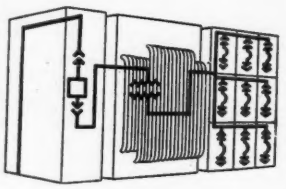
DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

UI

Unit Substation Application Chart

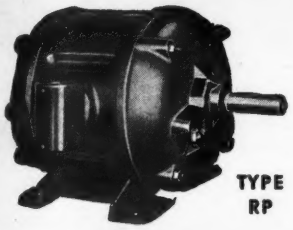
A quick reference chart showing standard and normal optional equipment in modern unit sub design. Other optional equipment may b e added but will require special engineering.

	SINGLE CIRCUIT SUBSTATION	MULTIPLE CIRCUIT SUBSTATION	LOAD CENTER SUBSTATION
			
COMPONENTS	In one metal-enclosed package unit: Three-phase transformer; Secondary breaker; Instrument transformers; Meters; Relays Standard connections: High voltage bushings; Low voltage bushings Normal optional equipment: Cable connections; "A" frame; Cover-mounted fuses; Lightning arresters	Three-phase transformer throat-connected to: Two or more steel-enclosed units, each containing: Vertical lift switchgear units complete with Instrument transformers, Meters and relays Normal optional equipment: Primary fuses (cover-mounted); Lightning arresters; Primary cable connection; Double-ended transformer arrangement	Three-phase transformer (indoor or outdoor) throat-connected to: Two or more steel-enclosed units, each containing: Low voltage switchgear with manually-operated Drawout type air breakers Normal optional equipment: Primary circuit breaker or Primary fuses and disconnect switch; Main secondary breaker; Electrically operated breakers
APPLICATIONS AND USERS	To reduce transmission voltages to 5 kv or less where only one secondary feeder is required Small municipalities Additional substation (Temporary or permanent) Small industrial loads Small emergency loads	To handle loads at 2400 volts to 15 kv where a number of secondary feeders are required Standard industrial or residential substations Distribution loops	To serve a number of loads 600 volts or less indoors or out from a high voltage source To serve small power and lighting loads below 600 volts near center of load Factory or industrial centers of load (motors, lighting or power)
RATINGS	CAPACITY Standard — 1000 kva to 5000 kva Special — 300 kva up	CAPACITY Standard — 1000 kva up (limited by secondary breaker size)	CAPACITY Standard — 100 kva to 2000 kva
	VOLTAGE RATINGS Primary — 13.2 kv to 66 kv Secondary — Below 5 kv	VOLTAGE RATINGS Primary — 12 kv and up Secondary — 13.2 kv to 2.4 kv	VOLTAGE RATINGS Primary — 2400 volts to 15 kv Secondary — Below 600 volts
TRANSFORMER EQUIPMENT	(Oil Cooled) NORMAL OPTIONAL FEATURES Load tap changer Forced-air cooling (automatic or manual) Thermal relay Delta-wye terminal boards	(Oil Cooled) NORMAL OPTIONAL FEATURES Same as single circuit substation Dry type transformer (For inside use below 15 kv primary)	(Non-inflammable Liquid Cooled or Dry Type) NORMAL OPTIONAL FEATURES Forced-air cooling for liquid-cooled transformers (automatic or manual) Thermal relay Delta-wye terminal boards
BREAKER EQUIPMENT	PRIMARY None	PRIMARY Breakers optional (for 15 kv and below only)	PRIMARY (Air or oil circuit breaker) Disconnect switch (with or without fuses)
	SECONDARY Electrically-operated vertical lift 50,000 to 250,000 kva breaker ratings (air or oil type) (Switchgear has facilities for all standard metering and instruments)	SECONDARY Same as single circuit substation (main secondary breaker often added)	SECONDARY Manually or electrically-operated drawout air breakers 15,000, 25,000, 50,000, 75,000, or 100,000 amps
	OPTIONAL None	OPTIONAL None	OPTIONAL Secondary metering equipment

Data from Allis-Chalmers Electrical Review

Wagner Polyphase Motors

Offer a Wide Choice of Electrical and Mechanical Types



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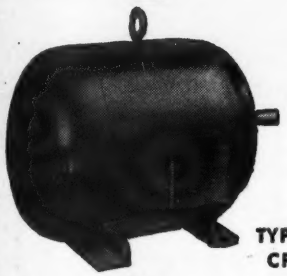
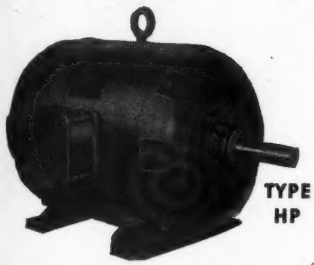
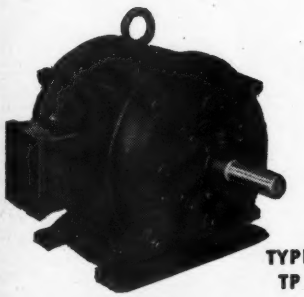


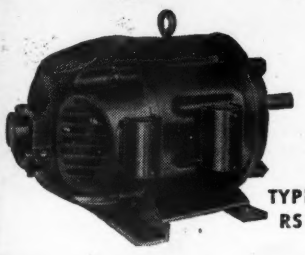
TYPE CP



TYPE HP



TYPE TP



TYPE RS

Fitting the right motor to the job is not always a problem of designing and building a *special* motor, but it is usually one of selecting a standard design of motor which is qualified to give the best account of itself.

Wagner polyphase motors are built in such a wide range of mechanical and electrical types that with few exceptions you can select a standard Wagner polyphase motor that exactly meets the requirements of the job.

SINGLE-SPEED SQUIRREL-CAGE

TYPES	ELECTRICAL CHARACTERISTICS	APPLICATIONS
RP-1, CP-1, HP-1, TP-1.	Normal starting-torque—normal slip	Group or individual drives on machine tools, fans and blowers, compressors, centrifugal pumps—on any application where normal-torque motors are satisfactory.
RP-5, CP-5, HP-5, TP-5.	High starting-torque—normal slip	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting-torque.
RP-6, CP-6, HP-6, TP-6.	High starting-torque—high slip, punch press	Punch presses, shears, metal-drawing machines, balers, and other machinery equipped with flywheels or having flywheel effect.
RP-7, CP-7, HP-7, TP-7.	High starting-torque—high slip, elevator	Elevators, cranes, hoists, dumbwaiters.
TYPES	**MECHANICAL CHARACTERISTICS**	**APPLICATIONS**
RP-1, RP-5, RP-6, RP-7.	Open—ventilated	For applications where atmospheric conditions permit use of open-type motors.
CP-1, CP-5, CP-6, CP-7.	Totally-enclosed, fan-cooled	For locations where dust, abrasives, steel chips, filings, acid fumes, moisture, and other harmful elements are present.
TP-1, TP-5, TP-6, TP-7.	Totally-enclosed, nonventilated	
HP-1, HP-5, HP-6, HP-7.	Explosion-proof	For Class I Group D hazardous locations where gasoline, petroleum, naphtha, alcohol, acetone, lacquer, solvent vapors, natural gas, and other flammable liquids are manufactured or handled.

MULTISPEED SQUIRREL-CAGE

TYPES	ELECTRICAL CHARACTERISTICS	APPLICATIONS
MRP-1 to -7, MCP-1 to -7, MHP-1 to -7, MTP-1 to -7.	Two, three, or four speeds, in 3 types: Constant Horsepower Constant Torque Variable Torque	For applications involving two, three, or four speeds. Frames varied as listed under "Mechanical Characteristics", and electrically varied as listed under "Electrical Characteristics" shown for single-speed motors above.

WOUND-ROTOR

TYPES	ELECTRICAL CHARACTERISTICS	APPLICATIONS
RS-1	General Purpose Continuous Duty	Conveyors, compressors, pulverizers, etc., requiring continuous operation.
RS-2	Crane & Hoist Intermittent Duty	Elevator, crane, hoist, and like services which operate intermittently.

For complete information on Wagner motors write for Bulletin MU-185, addressing your request to Wagner Electric Corporation, 6413 Plymouth Avenue, St. Louis 14, Missouri.

Send today for your free copy of Bulletin MU-185 which gives complete information on Wagner Single-phase, polyphase, and direct-current motors.

M46-17

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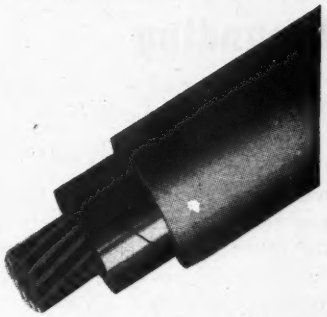

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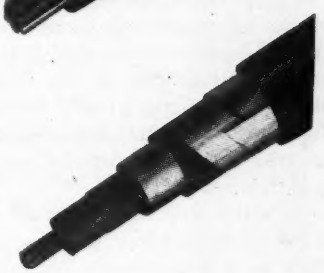
For power, heat or lighting circuits in central and sub-stations, mines and plants . . . for generator and motor leads, transformer, and oil switch leads . . . to operate at voltages up to 26,000.

ROEBLING RUBBER INSULATED POWER CABLE

Designed for operation up to 15,000 volts in power and light circuits and as apparatus leads. Made in moisture-resistant, flame retardant, weather-proof, oil-resisting and other special finishes.



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Widely used for general power supply and distribution circuits, underground or above ground. Made in a complete range of conductor sizes and constructions for voltages as high as 15,000.

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WIRES AND CABLES

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

Reader's Quiz

More on Rural Grounding

April's Reader's Quiz question No. 212 concerned methods of protecting against "trouble from lightning", on the premises of R.E.A. line customers who have water systems. Based on my experience of several years with a utility operating considerable mileage of rural lines, I am quite sure that neither answer published gave a complete answer and also that the second answer was incorrect.

Even under favorable conditions the resistance of a driven ground is likely to be relatively high, and on a typical rural line, even one using "common neutral" construction with a large number of driven grounds in parallel, the "impulse resistance" of the neutral conductor to ground can be relatively high. This "impulse resistance" is a measure of the voltage rise on the neutral conductor, above true ground voltage, when lightning currents are discharged to ground through "grounds" on the neutral conductor.

A water system in a house can have a low resistance to ground because there may be a considerable number of feet of buried pipe line connected. In a house with electric service with a driven ground and with a water system, the passage of lightning current to ground from the neutral conductor through the driven ground can cause a high difference in voltage between the neutral conductor and the water system. If the water system is driven by an electrical motor, the voltage difference can be many times the insulation strength of the motor, pressure switch, etc., and could cause breakdowns. Such breakdowns may act as a "safety valve", as in a house with electric service with a driven ground and with a water system without electric equipment, there could exist under some extreme conditions during a lightning storm a sufficiently high voltage between the electric wiring and the water system to cause injury to occupants of the house or damage to the property.

On rural distribution lines, it should be an inflexible rule that the neutral ground should always be connected to the water system, if one exists, in addition to any driven grounds used. This would prevent any difference in voltage between the neutral conductor and the water system, and this would eliminate one possible serious hazard.

In some cases it has been found helpful in addition to grounding the neutral to the water system to use small lightning arresters, such as the General Electric "Thyrite" meter protectors, connected between the "hot" wires and the neutral at a customers service entrance to keep at a safe level any voltage, due to lightning, between the "hot" wires and the neutral. In some cases this practice could reduce the failures of electrical equipment, such as on water systems.

The National Electrical Code specifies wisely that a "continuous metallic underground water piping system" shall always be used as the proper grounding electrode, if such a system is available. For rural distribution work, this should be interpreted, I believe, to apply to any buried metallic water system, though generally a driven ground should probably be used.—J.T

Slaughter House Problem

QUESTION 222—At our large slaughter house it is necessary to drive the cattle up a chute to the killing floor at the third story. It is customary in slaughter houses to use an electric prod pole, fed by a cord and ring sliding on a bare live wire which extends the length of the chute, to control the unwilling victims. The energy for this use is obtained from the 110 volt lighting circuit with one lamp in series.

Using 110 volt supply is the simplest and most fool-proof solution, but it does have bad effects on some cattle so that they don't bleed properly and occasionally it even kills one in the chute. Furthermore, there is the ever-present hazard of accidental contacting by humans. We have tried to use other sources of current with the objective of limiting the current capacity.

Fence controllers don't work very well. Spark coils work all right in driving cattle into trucks, but they don't seem to produce results at the killing floor. (There is some difference of opinion about whether or not a cow is sensible to the smell of the blood.) A 24 volt transformer works all right if the cattle are wet, but some meat inspectors won't permit cattle to be wet down.

Perhaps there is someone who has a simple solution to this problem or can tell me why the spark coil doesn't work at the killing floor. Our main objective, as I mentioned before, is to use a source with a definite limit in current capacity.—T.R.H.

A. TO QUESTION 222—A stunt which was used for another purpose over 25 years ago may be the solution to the slaughter-house problem.

We used a telephone magneto with an interrupter in series. This interrupter was a gear similar to the large magneto gear to which the crank was attached. This arrangement was limited in power by the magneto output, but the mechanical interrupter increased the frequency with "shocking" results.

A magneto test may be arranged by making a brush of fine stranded wire, supported to lightly contact the larger gear teeth of the magneto. If the armature has one end of the coil grounded, this will be one side of the circuit, and the insulated lead will be the other. Hand cranking will be necessary in making the test.

If this method gives satisfactory results, it would be advisable to install better bearings in the magneto, possibly small ball bearings. The interrupter may be made of insulated discs with segments or a small bar commutator using each alternate bar.—H.V.K.

PARANITE PARASYN

TYPE T and TW BUILDING WIRE

For New Wiring—Rewiring—and Maintenance Wiring

T – 600 V – – – – – PARANITE – PARASYN

– B – TW – 600 V – – – – – PARANITE – PARASYN

Thermoplastic Insulation
Non-Braided

RESISTS FLAME

RESISTS OILS and GREASE

RESISTS ACIDS and ALKALIS

RESISTS MOISTURE (TYPE TW ONLY)

If It's PARANITE It's Right!

PARASYN thermoplastic small diameter building wire is ideal for new wiring, rewiring, and maintenance wiring. It is easy to pull in conduits, and strips fast and clean.

The thermoplastic insulation of both TYPES T and TW has long life, is high in dielectric and mechanical strength and is resistant to FLAME, OILS AND GREASE, ACIDS AND ALKALIS.

Black is standard, but also available in broad range of colors.

TYPE TW is especially recommended for wiring in wet locations.

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Electrical Wires and Cables *"Better Than Code Requires"*

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COMBINATION!

KLIPLOK CLAMPS
Supply needed pressure for easy flow of current!

- Increase fuse life.
- Prevent burnt fuses and clips.
- Stop unnecessary shutdowns.
- Save power.
- Reduce fire and accident hazards.

TRICO "Powder-Packed" RENEWABLE FUSE

This " different " fuse gives maximum protection and THREE TIMES the SERVICE at no added cost. Custom-built renewal element, " powder-packed " feature, and rugged construction make possible the following advantages . . .

- Tamperproof protection.
- Non-interchangeable link.
- Safe time-lag.
- Link support.
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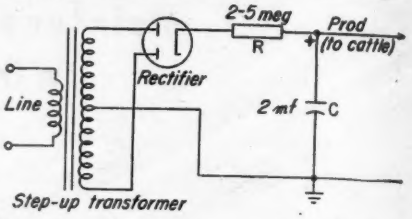
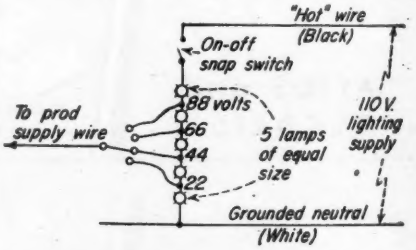
A. TO QUESTION 222—The spark coil has the disadvantage of not controlling the amount of current conducting through the cattle. One solution which I know has worked reliably, is to use a condenser which is connected in a charging circuit. The charging time must be several seconds long, and this is achieved by connecting a high resistance (several megohms) and a high capacity (for instance 2 micro-farads) in series across the d-c supply. The condenser is discharged



through the animal, and the results are the same regardless whether the cattle are wet or not. The voltage needed is 400 to 600 volts. This high voltage may seem dangerous at first, but the amount of electrical charge in the condenser is so small that this method is safe for animals and the human attendants. The d-c voltage supply is obtained by a suitable step-up transformer and rectifier, and is inexpensive because no filter is needed and the current drain is negligible.—S.V.H.

A. TO QUESTION 222—The lamp in series with the prod pole supply is a current limit and may be adjusted by the use of different sizes of lamps. For example, if a 60 watt 110 volt lamp is used, the maximum current is limited to 60/110 or .55 amperes even though the sum of the series resistances of the prod supply, the prod,



and the cow approach zero. The use of a 40 or a 25 watt lamp would reduce the maximum current accordingly.

However, the problem as presented is one of voltage adjustment rather than that of current limit. Regardless of the size of the series lamp, or if no lamp was used, the voltage from the tip of the prod pole to ground is a full 110 volts on open circuit. The series lamp reduces the 110 volts only by the amount of the IR drop across the lamp which is zero on open circuit. The fact that a 24 volt transformer gives good results under certain favorable conditions indicates that a slightly higher

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ACE SHOP EQUIPMENT

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Powerful *ACE WINDERS* will pull the heaviest wire for the largest coils in their range — have life-time non-grab, positive clutch control — gear and belt drives engineered to eliminate chatter — and will take all types of winding heads.

Sturdy *ACE COIL FORMERS AND SPREADERS* stand up under severest service — are smooth and positive in action.

Built to last a lifetime, an investment in Ace Shop Equipment pays dividends every year in satisfaction and profit. Shipment is prompt — from factory stocks.

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The Superior carbon brush distributor in your vicinity is a good man to know. He has been chosen to serve you because he is thoroughly versed in his subject, because he is morally and financially responsible, and because he can stand behind our product truthfully and enthusiastically. If you have not met him, may we introduce him?
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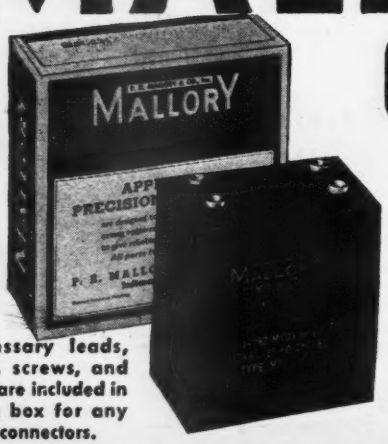

Necessary leads, lugs, screws, and nuts are included in each box for any type connectors.
Mallory MSG Capacitor:—Small, compact AC Motor Starting Capacitor that fits almost every mounting bracket or box. Replaces rectangular capacitors with leads, lugs or studs. Each capacitor is packed with complete set of universal mounting hardware and installation instructions.
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voltage or a readily adjustable voltage to suit the varying conditions would solve the problem.

The potentiometer shown in the sketch is an inexpensive device to make and will give accurate voltage adjustments.

The sketch shows 5 lamps in series and the voltage to ground of each step is indicated. The use of more than 5 lamps will give smaller voltage steps. The prod supply wire may be connected directly to a binding post between two lamps but the selector switch as shown will be more convenient. A small amount of power will be consumed continuously when the switch is closed even though the prod pole is not in use. Five 60 watt lamps will only draw 12 watts. The size of the lamps is unimportant but the lamps should be of equal watt ratings to give the voltages as shown. The indicated voltages are open circuit ratings and when the prod is in use, will vary slightly depending on the resistance of the prod to ground.—R.G.B.

Rewinding Chargers

QUESTION 223—We have a Hobart C. P. battery charger rated at 300 amps at 9 volts. We would like to know if the fields of this unit can be rewound for use as a welder without rewinding the armature. If so, what is the formula?—F.H.

A. TO QUESTION 223—You would have to increase the speed and field strength to get a higher voltage. A separate exciter will help. Use a series resistance in the exciter circuit, which can be shorted out each time you weld or start to weld. To get the drooping voltage, you will need a series armature resistance.

This will not behave as good as a 70 volt generator which has a shunt and a bucking series field 90 percent of the shunt field strength.—H.S.

A. TO QUESTION 223—Depending upon the original design and armature winding, it may be possible to avoid rewinding the armature.

A parallel winding can be connected series and a wave wound armature can be reconnected lap to give twice the generated voltage, field ampere turns remaining the same. As 18 volts will hardly be sufficient in striking the arc, it will be necessary to increase the voltage approximately 40 percent. This can be accomplished in one of two ways (a) increased field strength, (b) increased speed.

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

Cool!

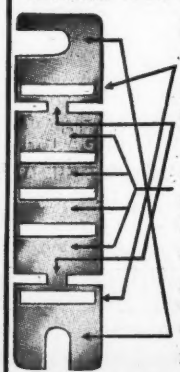
THE FIRST COOL OPERATING FUSE DESIGNED BY WARE

A Cool Operator!

WARE HI-LAG Renewable FUSES

Cool Facts No. 1

Strong Time Lag—2 to 5 times normal current, for handling starting overloads and operating surges. Link is one piece of metal, one thickness throughout affording unexcelled time-lag characteristics.



Fast opening on short circuits.

Expansion without sharp bending.

Area to absorb heat of motor starting current and short heavy surges.

Terminals are wide and heavy to provide maximum contact area — reducing heat.

APPROVED BY UNDERWRITERS' LABORATORIES

To secure adequate protection, yet end needless delays and costly shutdowns, calls for WARE HI-LAG Fuses. Scientifically designed and constructed to reduce excessive heating during "round the clock" schedules, heavy current loads and starting surges.

The construction of WARE HI-LAG Renewable Fuse provides every advantage for maintaining low contact resistance and strong time lag—up to five times normal current.

The Links—the knife-blade assembly—the double bridge supports—the spring tension contacts and greater contact surface are exclusive features which reflect the superior qualities of this amazing cool operator.

Try WARE HI-LAG on your toughest production line—you'll find what most engineers are daily proving—that their GUARANTEED Performance rates them the Best—Most Economical—and Lowest Cost Fuse to install.

Write for Brochure giving detail of all their COOL FACTS, sizes and prices.

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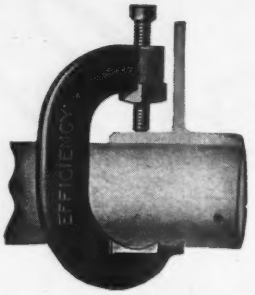
EFFICIENCY CONDUIT HANGERS FOR INDUSTRIAL CONSTRUCTION



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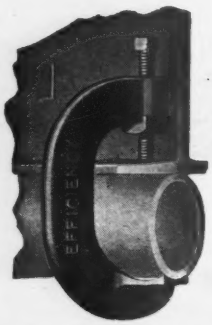

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For ½" and ¾" conduit
For 1", 1¼" and 1½" conduit
For 2" and 2½" conduit

WRITE TODAY for our Catalog No. 38 . . . contains complete information on this and other EFFICIENCY Electrical Devices

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BM BRIEGEL METHOD TOOL CO. • Galva, Ill.

The following formulas apply:

$$IN_2 = \frac{E_2 IN_1}{E_1} \qquad RPM_2 = \frac{E_2 RPM_1}{E_1}$$

Where
IN_2 = required ampere turns
E_2 = required voltage
IN_1 = original ampere turns
E_1 = original voltage
RPM_2 = required RPM
RPM_1 = original RPM

The new rating will be volts 25, amps 100. Suggested drive direct connected 5 hp. induction motor.—T.B.B.

Can you ANSWER these QUESTIONS?

QUESTION C10—I installed a 3 phase, 220 volt, 15 hp. motor-generator set, changing a-c to d-c. This set has conventional system grounded, as well as equipment grounded. What I would like to know is why d-c voltage never quite comes back as high as it was when set is shut down, sometimes for only a couple of minutes. D-c field rheostat's position remains the same.

For instance, I start M-G set. D-c voltage climbs to, say, 110 volts. Leaving field rheostat alone, I shut down set. After voltage drops to zero, I start set up again (leaving rheostat alone). This time, d-c voltage will rise only to 100 volts. I shut down set, then start set up again, voltage will only rise to, say, 90 volts, and so on.

Is there anything wrong with this motor-generator set? Or hook-up?
—P.L.C.

QUESTION D10—How can we soften wire on small armatures to take data? If we apply heat on some varnishes, it gets harder.—H.R.

QUESTION E10—We are installing a photo electric cell controlled door in our building that will slide open and shut on a track. Can some one give us a system that can be used to give the following action?

As the customer enters and breaks the beam, the door starts to open. The customer starts back, restoring the beam and the door stops at this point and starts closing. The customer then comes back, breaks the beam again, causing the door to start opening again without having ever gone completely shut. In other words, the door could be made to go forward or backward by breaking and making the beam, and would move back and forth without going wide open or clear shut.—J.F.

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National Electric IPI* bus takes care of the Future

*Industrial Plug-In Bus

National Electric IPI Bus installation in this large plant assures easy addition or relocation of machinery.

★ A flexible, electrical distribution system.

★ Plug in new machines anytime—*without interrupting service.*

★ Bus mounted so that "Plug-In" devices can be inserted from either side, or top and bottom.

★ Bus bar sizes may be changed, increasing capacities, using same housing and insulators.

★ "Plug-In" doors every 15", side-staggering locates outlets every 7½".

★ Hanger bolts support bus independently of housing.

★ Rugged insulator assures long life.

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INDUSTRIAL IPI PLUG-IN BUS

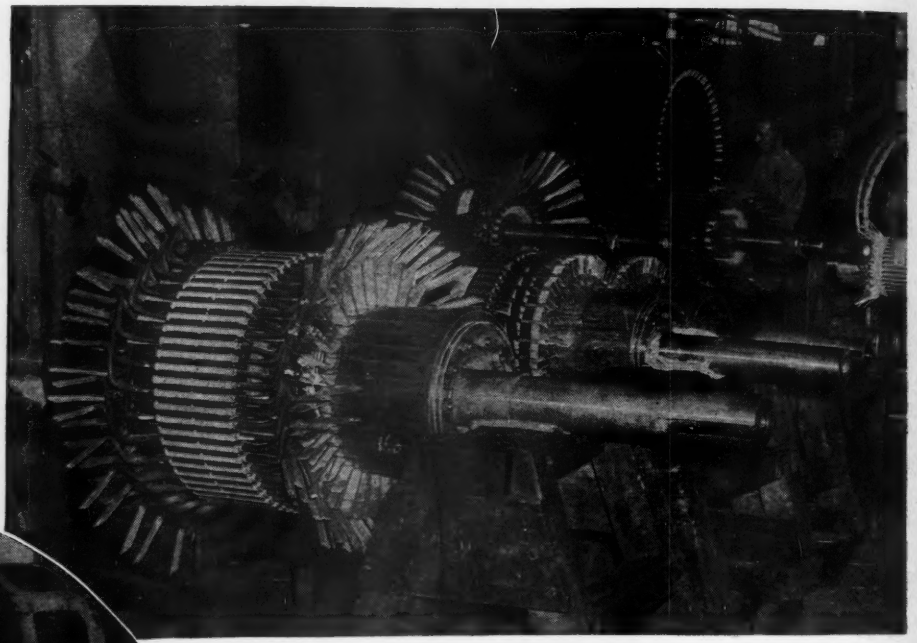
NATIONAL ELECTRIC PRODUCTS NE WIRING SYSTEMS

Approved by Underwriters' Laboratories, Inc.

Synthite* PX-5

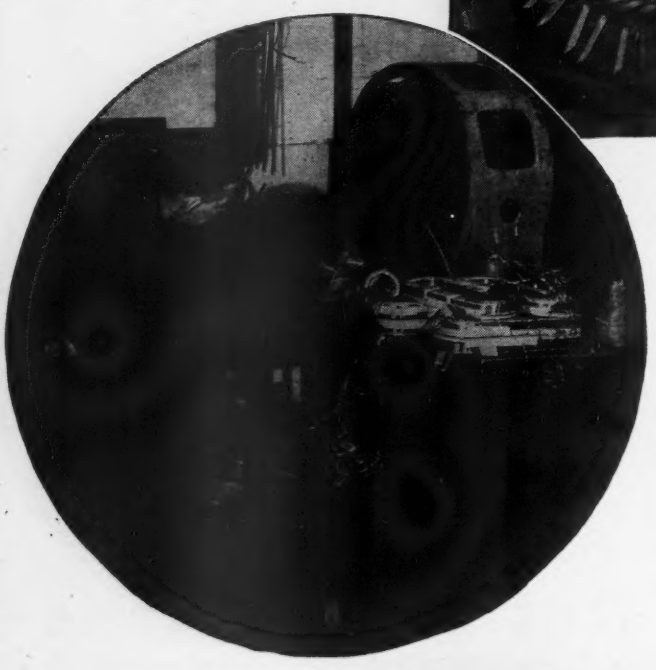
BLACK BAKING VARNISH

In Production · · · · Or Repair



Yes, the versatility of this all-purpose black baking varnish makes it equally at home in either large scale manufacturing operations or repair shop overhauling and maintenance work.

The Hanson-Van Winkle-Munning Company, Matawan, New Jersey, a leading manufacturer of electro plating and polishing equipment, specifies SYNTHITE PX-5 as their production varnish. Ease of handling, exceptional dip-tank stability, together with the ability to adapt itself to a wide range of baking temperatures aids immeasurably in stepping up production with "reject-free" results.



In today's repair shops, where all types of electrical equipment are taken in for maintenance and overhaul, it is most difficult to find a baking varnish that can be used satisfactorily on such a wide variety of applications. However, many of the more progressive shops; such as Lockwood's Electric Service, Trenton, New Jersey, are using SYNTHITE PX-5 with excellent results on all types of wound coils, stators, armatures and transformers.

If yours is an application where you require a deep drying black baking varnish that is oil and waterproof . . . acid and alkali resistant . . . suitable for use on all types of coated wire (Formvar, Formex, Glass, etc.) . . . it would be worth while to write us for additional information on SYNTHITE PX-5. A working sample is available to you on request.

* Reg. U. S. Pat. Off.

Insulating Dolph's *Varnish Specialists*

JOHN C. DOLPH COMPANY

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Motor Shops

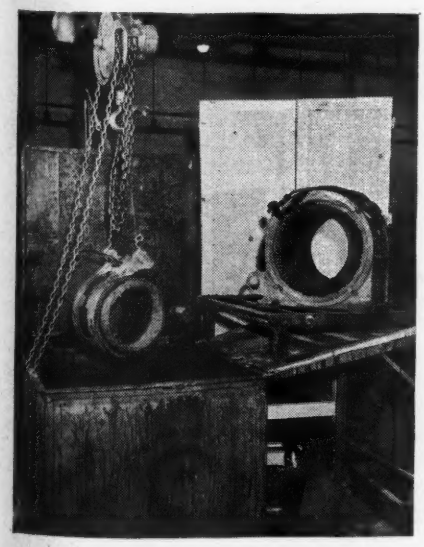
Drain Board Speeds Dipping Process

During rush periods in the motor repair shop, the dipping facilities can frequently become somewhat of a bottleneck in the smooth operation of the normal production line technique. The most common cause for a slowdown at this point of the repair routine is the normal shop practice of suspending dipped rotors and stators directly above the varnish tank while draining. Net result: the dip tank is usually out of use—particularly when large motors are dipped—until drainage ceases; the other motors, awaiting their turn, begin to pile up in the vicinity of the tank.

To preclude the development of such a condition in its shop, the Rockford Power Machinery Equipment Company, Rockford, Ill., came up with a simple and inexpensive dip tank accessory—a drain board. The 1½-in. angle-iron framework for the drain board is 37 inches long and the same width as the dip tank. Fastened to the top flange of the tank, the board is elevated at an angle of approximately 20 degrees to the horizontal and supported by two braced angle-iron legs. A removable sheet-steel pan with flanged sides rests on the frame. To keep the dipped motor in a horizontal position while draining, a grate with two short legs at the tank end was fashioned from 2-in. and 1½-in. angle-iron. This rests on top of the steel drain pan.

After a motor has been dipped and its coils impregnated with insulating varnish (Glyptal being used in the tank illustrated), it is placed on the grate. While this first unit is draining, a second rotor or stator can be placed in the dip tank. The Rockford shop reports that it takes approximately an hour for a stator to drain completely. Varnish is removed from the motor frame with a brush and gasoline. Practically all the excess varnish that drains from the motor is recovered and flows back into the tank.

Since the drain board accommodates one or more motors, depending on size, the dipping process is accelerated considerably and the dip tank can be used constantly. If the rush of work is such that more drainage space is necessary, a similar board can be attached to the other side of the tank.

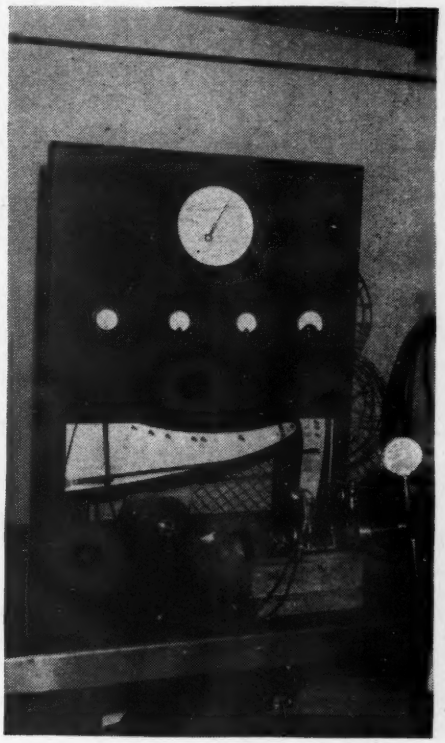


Dip tank drain board accelerates motor shop repairs. While varnish drains from stator (or stators) on board, other units can be dipped. Practically all excess varish is recovered and flows back into the tank.

Tests Guarantee Characteristics

Before placing a guarantee on a-c motors repaired in their shop, the Arimingo Electric Company of Philadelphia, Pa., checks all nameplate data under actual full load and overload test conditions. The bench mounted testing dynamometer, a product of Philadelphia's Howard Davis Company, is designed for all a-c motors with power ratings up to 5 hp. and speeds up to 3600 rpm.

A cantilever-pivoted, curved metal arm with definite weight and dimensions, is positioned across the bottom of the panel. The gravitational pull on the cantilever arm is opposed by an upward pull exerted through a flexible cable attachable to the arm at varying distances from the pivot and rising to an overhead sheave on the rear of the test board. Through a series of pulleys the cable is led from this sheave to a friction drum turned by the motor under test. As the cable is tensed around the drum the torque of the motor is transmitted by friction to the cable and the cantilever is raised. The load on the motor is varied in proportion to the tension on the cable. A tachometer, geared to the friction drum, continuously indicates the rpm. while meters on the face of the board, calibrated up to 250 volts, 50 amps. and 3 kw., furnish visual data concerning motor characteristics under all conditions from no load to the stalling load. The mechanism of the test panel is capable of reproducing conditions equivalent to 500 percent overload.



Dynamometer checks a-c motor characteristics in accurate shop test prior to final guarantee. Motors up to 5 hp. and 3600 rpm. can be tested under conditions equivalent to 500 percent overload.

Cleaning Small Armatures

A simple, rapid method for burning out damaged coils in the process of cleaning armatures of small motors has been extensively and successfully used by John Phillips of Boulder City, Nevada.

Sheet mica is wrapped around the armature and approximately 20 turns of No. 20 wire are wrapped around the mica. The ends of the No. 20 wire are dead-ended by terminal insulators and leads from either end of the wrapping wire are connected to a 110-volt circuit. A hand make-and-break switch controls the current passing through the

Now in production in our Philadelphia factory.

ONE MAN DOES IT!

with a

Midget "Megger"* INSULATION TESTER

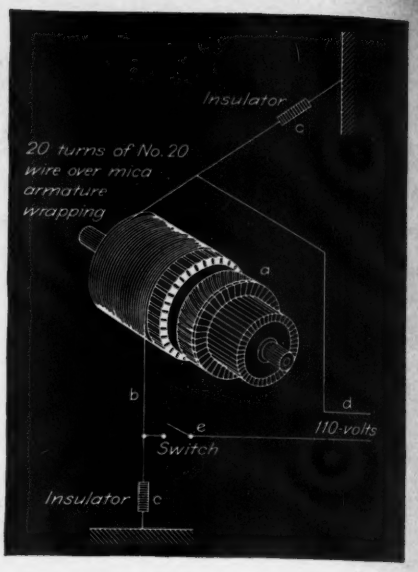
Making important check tests of insulation resistance is a one-man job with any type of "Megger" Insulation Tester. For example, the illustration shows our Midget type being used for a periodic test on one of a group of fire-pump motors. After making connections, the operator merely turns the crank of the hand generator—and reads resistance directly on the scale. It is done as simply and quickly as the telling.

The Midget "Megger" Tester is ideal for maintenance and trouble-shooting because of its light weight, small size and ready portability. The hand-cranked generator makes it independent of batteries or external power supply—it is instantly ready for testing insulation resistance of almost any type of electrical equipment. Reads up to 50 megohms and delivers 500 volts d-c. Supplied also in ratings of 10 megohms, 100 volts and 20 megohms, 250 volts.

For periodic maintenance tests or where trouble has occurred the Midget "Megger" Tester has won wide favor with the men who use it. Its low cost has been attractive. For complete description write for Bulletin 1785-EC.

** By special arrangement with the British makers of "Megger" instruments our American-made models carry the U. S. Registered Trade-mark "MEGGER".*

JAMES G. BIDDLE CO. **1316 ARCH STREET PHILADELPHIA 7, PA.**



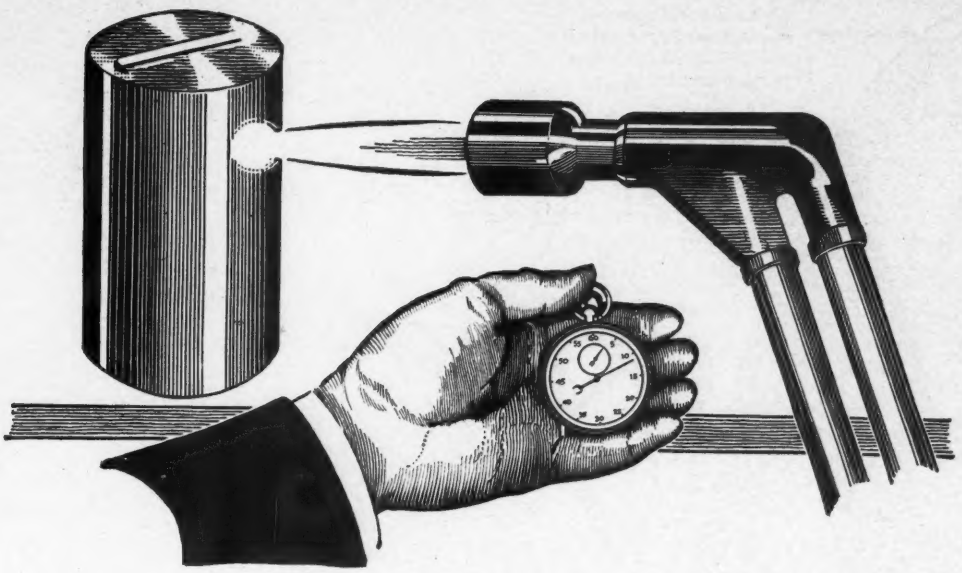
Damaged armature coils of small capacity motor (a) can be quickly burned and removed by a simple shop method creating induced heat in the coils. No. 20 wire (b), wrapped around mica sheathing and dead-ended by insulators (c), carries current from 110-volt circuit (d) which causes temperature rise. Hand switch (e) interrupts current and controls resultant heat.

circuit and the resultant induced heat inside the mica armature sheathing. Approximately 10 minutes are required to completely burn the armature windings of a ½-inch capacity portable drill. The coil fragments then can be lifted out as a unit and the slots thoroughly cleaned.

Thermocouples Show Motor Overloads

During the war numerous applications of under-sized electrical equipment, particularly motors, were made because of the necessary restrictions on the use of critical metals. Upshot of this policy, important as it was at the time, was the failure of many motor installations under the strain of continuous operation. Motor shops received motors with windings burned to a crisp and were asked to rewind them with an insulated conductor that would stand up under the overload (normal full-load for the proper size motor). The solution in many cases was the use of glass insulation.

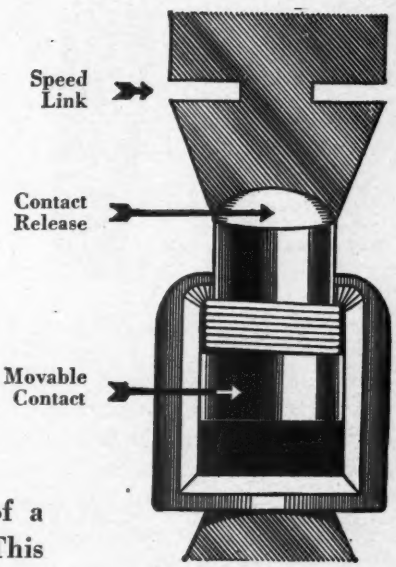
Typical example of this condition was found in the motor repair shop of the Smith-Milligan Electric Company, Tulsa, Oklahoma. An oil pipe line company sent in a burned-out 500 hp., 2300-volt, 3-phase, 3555 rpm. pump motor to be rewound for 600 hp. duty. Normally a 600 hp. motor would have been installed, but a 500 hp. unit was the largest they were permitted to use during the war. Full load on the pump was between 500 and 600 hp.



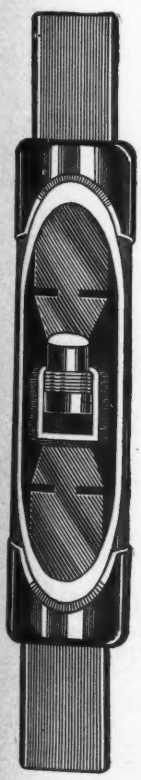
IT TAKES A LONG TIME

to heat a block of copper hot enough to melt a piece of solder attached to it. This is the way a TRION works. The solder of its contact release melts only when the copper mass of its movable contact is sufficiently hot.

Similarly, a motor or transformer has a heat-absorbing capacity which becomes harmful only at a certain temperature. A TRION reproduces — that is, it matches — this capacity. It interrupts the circuit only when the motor or transformer load, if increased, might cause damage. Thus a TRION avoids unnecessary shutdowns, giving the fullest scope of safe operation with complete protection at all times.



The time-delay of a TRION averages nine times that of an ordinary fuse. Also, the low watt-loss of a TRION preserves the life of fuse-clips and switches. This in itself is a point you cannot afford to overlook. Ask us or our nearest representative, now, about TRION, the dual-element, 3-in-1 fuse.

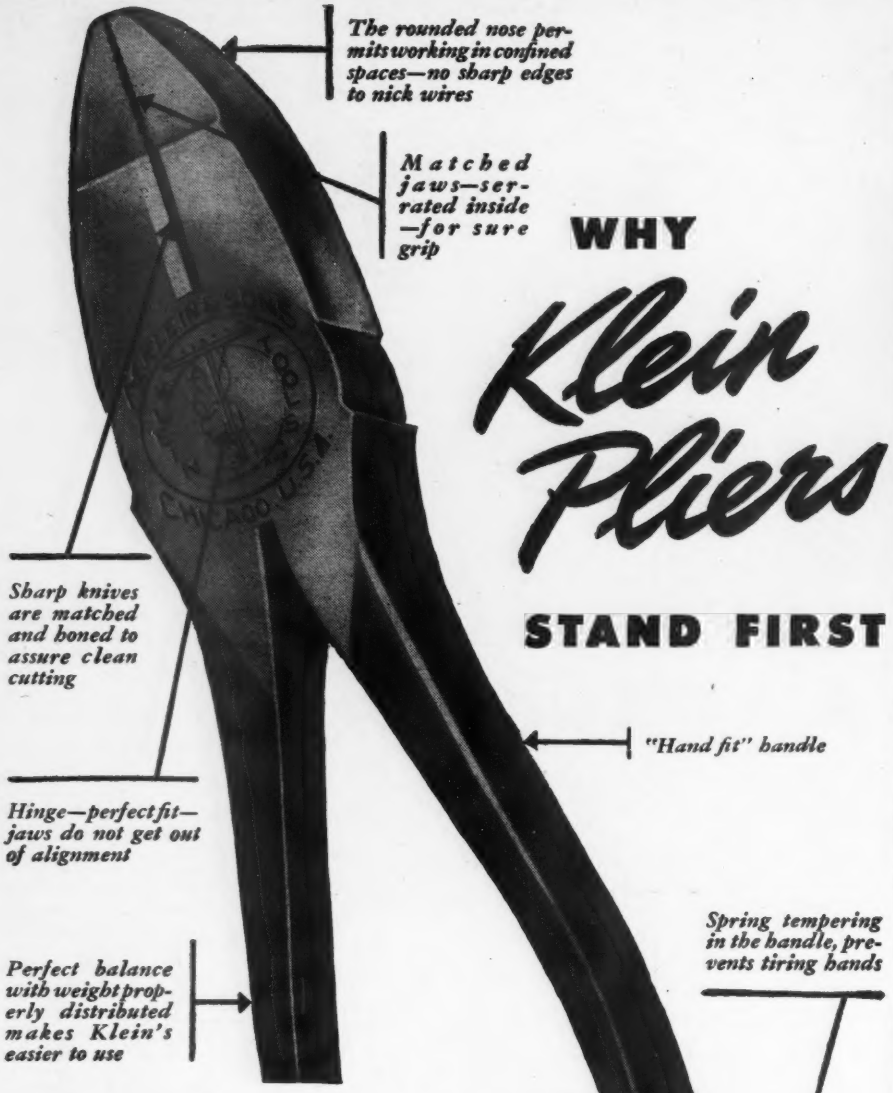


Trion

DUAL-ELEMENT — THREE-IN-ONE — TRIPLE PROTECTION

THE CHASE-SHAWMUT COMPANY, NEWBURYPORT, MASSACHUSETTS

Boston, New York, Syracuse, Philadelphia, Baltimore, Atlanta, New Orleans, Dallas, Detroit, Columbus, Indianapolis, Chicago, Omaha, Kansas City, St. Louis, Minneapolis, Denver, Los Angeles, San Francisco, Seattle


The rounded nose permits working in confined spaces—no sharp edges to nick wires
Matched jaws—serrated inside—for sure grip
Sharp knives are matched and honed to assure clean cutting
"Hand fit" handle
Hinge—perfect fit—jaws do not get out of alignment
Spring tempering in the handle, prevents tiring hands
Perfect balance with weight properly distributed makes Klein's easier to use

WHY

Klein Pliers

STAND FIRST

Ask a lineman—electrician—or a skilled craftsman in any field why he prefers Klein pliers. He may mention the balance of Kleins that makes them feel comfortable—the sharp knives that stay keen even after years of service—the jaws that grip tight or the spring in the handles that prevents tired hands.

All of these qualities are evidences of the careful design—the years of experience—the hand-craftsmanship methods by which Klein pliers are made.

But even more they typify the careful control of every step in the manufacture—from the specification of the high grade tool steel made to our analysis to the individual inspection every pair of Kleins receives before it is boxed ready for shipment.

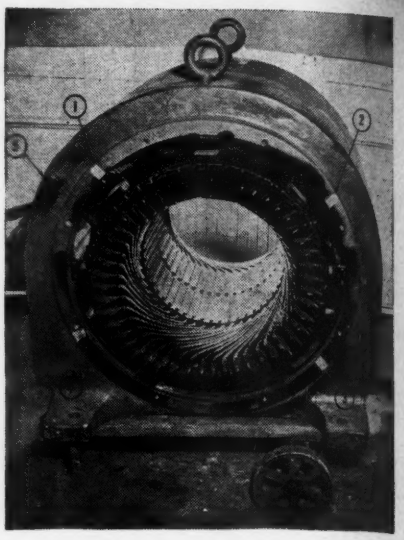
Everything possible is being done to satisfy your requirements for these quality pliers, but demand still exceeds supply. Keep Kleins on order—your supplier will fill your order as soon as possible.

ASK YOUR SUPPLIER

Foreign Distributor:
International Standard Electric Corp., New York

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVENUE CHICAGO 18, ILLINOIS

Since 1857



Operating range of this 500 hp., 2300-volt, 3-phase pump motor for an oil pipe line was boosted by rewinding with glass insulated conductors. An added safety precaution against overheating was the installation of thermocouples in the bottom of stator slots at points 1, 2, 3 and 4. Temperature indicating instruments are plugged in at jack terminal (5). Continuous duty motor operation is maintained at or below full-load temperature determined by load test (temperature—load curve).

Smith-Milligan rewound the unit with glass insulated conductors to withstand the higher temperatures encountered under constant operation.

As an additional precaution against unheralded failure due to overload, the pipe line company engineers requested the installation of thermocouples so they could keep a constant temperature check. Smith-Milligan installed four thermocouple elements in the bottom of the stator slots at the points indicated in the accompanying photograph (points 1, 2, 3 and 4). These elements terminate in a six-gang jack-type connection block (two spare sets of terminals) into which temperature indicating instruments can be plugged (point 5 on the photo).

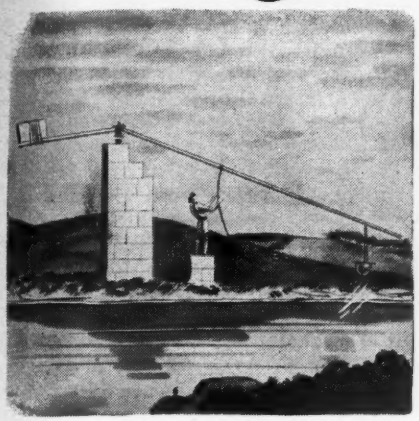
To determine the critical (full load) operating temperature of the motor a temperature-load curve (temperature vs. amperes input) was plotted from an actual test run on the motor. This ranged from a "cold test" up to an above full load. With a knowledge of the full-load operating temperature of the motor and the temperature limits of the insulation used, the pipe line engineers were able to keep the pump motors operating.

Connecting Pigtails To Carbon Brushes

Motor repair shops find carbon brush replacement or repair a common item among the many operations involved in

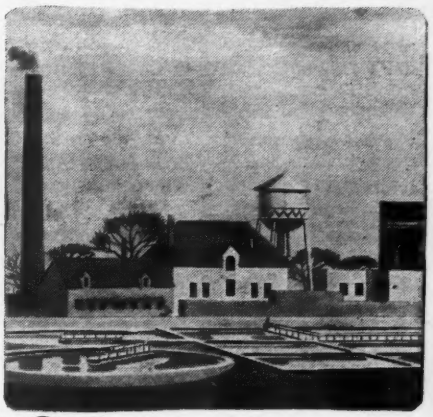
Old Reliable Red Band Says—

"It all started with a Bucket Brigade!"*



1 Earliest recorded mechanical waterworks system was known as the *"Shadoof."* Water was scooped for the Pharaohs' water supply out of the Nile. . . . Relays of slaves worked chains of buckets, day and night. . . . In 1485 B.C., the exiled brother of Rameses II took this method to Greece.

2 As early as 300 B.C., miles of crude, hand-made aqueducts were carrying water from Alpine springs to Rome, where matrons filled household water jars at public fountains in the streets. . . . Early American colonists dug community wells—built cisterns to catch rain water.



3 Today, electrical horsepower from thousands of industrial type motors pump water for public requirements and industry—pump fluids for industrial processes. . . . Howell has specialized in building motors for pumps and other industrial needs for more than 30 years.

Have you a hard job for Horsepower?

Howell Motors are better than ever today. The reasons: Years of experience in building industrial type motors to meet the exacting requirements of the automotive, machine tool, dairy, food and other important industries.

Howell Motors are quality-motors. They are smooth-operating because they are statically and dynamically balanced. They are better performing because they are built of the finest materials — copper or bronze rotors — and completely insulated. They are trouble-free on the job because they are designed for the toughest tasks in industry — consequently, they perform better on all jobs.

For your needs, in specialized or standard motors, phone the nearest Howell Representative. Remember, you pay no more for industrial type Howell Motors . . . but you always get top quality for your money.

**Another historic story by Old Reliable Red Band*

Howell Protected Type Motors available in sizes 5 h.p. and smaller. Also other sizes of Howell industrial type motors available up to 150 h.p.

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Manufacturers of Quality Industrial Type Motors Since 1915

KEEP 'EM PROUD

OF YOUR LIGHTING JOBS...

BY USING *WATCH DOG STARTERS THROUGHOUT**

When you first install a fluorescent lighting job, everybody's proud of it, and your reputation rises.

But are you sure they'll *stay* proud of it as time goes on? You will go a long way toward being sure, if every fixture is equipped initially with G-E Watch Dog starters.

Watch Dogs keep the job completely free from blinking and flickering lamps as the lamps reach the end of their service life. A built-in "cut-out" prevents the futile attempts to start dying lamps, protecting the ballast and the starter itself.

Fluorescent lighting installations which *start out* equipped with Watch Dogs *continue* to add to your reputation as a fluorescent lighting expert. Because the user finds his maintenance costs are low, because his relamping is so simple, he's a prospect for more fluorescent lighting. And on older installations, too, a complete change-over to Watch Dogs is your best move to more user satisfaction and more fluorescent profit.

For full information on G-E Watch Dogs for 20- to 100-watt lamps, see your G-E Merchandise Distributor, or write Section G10-8-8, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

***Trade-mark Reg. U. S. Pat. Off.**

GENERAL ELECTRIC

repairing or reconditioning electric motors and generators. Sometimes the complete brush can be taken out of stock; frequently it has to be made up at the shop (from slabs of carbon kept in stock for such purposes). Often, broken flexible pigtails must be replaced. In this period of shortages, brushes are frequently fabricated in the shop to overcome delivery delays and get the customer's motor back into service in the shortest possible time.

Among the many "shop kinks" or ideas entered in last year's NISA Award Contest was one dealing with this specific problem. Submitted by Leo Ulatowski, employee of the Arthur Wagner Company in Chicago, it outlines a time-tested method of fastening flexible pigtails to carbon brushes. The item was one of many recently released by NISA headquarters for publication.

Ulatowski's simple and effective method is illustrated in Fig. 1. First, a hole with a diameter slightly larger than

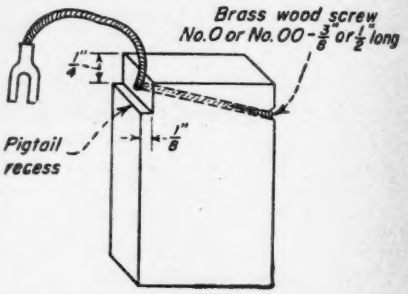


FIG. 1—Method of fastening pigtails to carbon brushes is illustrated above. Note slanting hole, pigtail recess and flat head retainer screw.

that of the flexible pigtail is drilled at a downward angle through the width of the brush (centered in the brush thickness). Drilling at such an angle provides additional protection against splitting the brush when the pigtail retainer screw is inserted at the bottom of the hole. Next, the pigtail is recessed by cutting away a small section of the brush at the top of the hole. This keeps the pigtail out of the way whether the brush is below the brush-holder box or the pressure finger is on top of the brush.

The free end of the flexible pigtail is then inserted and pushed to the bottom of the slanting hole where it is held secure by an ordinary small brass wood screw—either round or flat head. A flat head screw is preferred since it usually will counter-sink itself into the comparatively soft carbon. When the screw is inserted it does two things: it jams the flexible lead tightly against the wall of the hole; it cuts its own thread path into the carbon and embeds itself securely.

Ulatowski warns that this screw must be inserted carefully to prevent brush splitting but adds that a bit of experience will eliminate any damaged units. This method has been used for three years.

UNI-SHELL

R & M GIVES YOU *IDENTICAL* MOUNTING DIMENSIONS IN *ALL* MOTOR TYPES

Interchangeability—the same dimensions in shell, bolt circle, head fit, base, and shaft diameter and height. That's what you get in Uni-Shell motors. Whether they be open-type, drip-proof, splash-proof, or *totally enclosed*, all motors of the same frame size fit into the same location.

This feature of *complete* interchangeability in integral horsepower motors simplifies conversion and reconversion. When environment requires that motors have a greater degree of protection, or should current characteristics change, installation of the type of motor desired involves no alteration of supports—no mounting difficulties in close clearances. Makers of machines having built-in motors, with or without special heads, find Uni-Shell adaptability an *economical* answer to the vexing problem of motor variety.

Standardization is but one of the *many* improvements in R & M Uni-Shell motors—the finest in *every* way that we have produced in over 50 years. Plan now to get these benefits—in your plant; on your products. Literature and helpful engineering aid are yours for the asking.

ROBBINS & MYERS · INC. MOTOR DIVISION · SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co. of Canada, Ltd., Brantford, Ont.

MOTORS · HOISTS · CRANES · MACHINE DRIVES · FANS · MOYNO PUMPS FOUNDED 1878

At little or no extra cost

Get Double Protection

against Motor Burnouts from Overloads or Single Phasing by installing FUSETRONS

OF COURSE, larger motors are protected with thermal cutout or overload relays. They save many motors, but experience shows that such mechanical devices sometimes stick or fail to operate—and a motor burns out.

You can give motors DOUBLE PROTECTION against burnout from SINGLE PHASING or any dangerous electrical OVERLOAD, simply *by replacing fuses used for short-circuit protection with Fusetrons* of motor-running protection size.

Fusetrons give same short-circuit protection as fuses and should thermals or relays fail to operate for any reason the Fusetrons will act independently to save the motor.

● *Why this double protection COSTS LITTLE OR NOTHING*

Large size fuses are replaced with SMALLER size Fusetrons. This means a step down in the price range.

For example: The lowest cost 100 amp. 250 volt fuse costs approximately $0.34. A 60 amp. Fusetron to replace it costs about $0.30—(BUSS Fuse Reducers to make the change possible costs but little and need never be replaced).

That is why you need not worry about the cost of replacing fuses with Fusetrons even though installing Fusetrons means that you REDUCE MANY MANY TIMES THE CHANCE OF HAVING A MOTOR BURN OUT.

On new installations you ACTUALLY SAVE MONEY because proper size switches or panels are installed instead of oversize equipment needed to take fuses large enough to hold motor starting current. The smaller size Fusetrons used further reduce costs.

● *Why Fusetrons Can Give Motor-Burnout Protection*

Fusetrons have a tremendous time-lag, due to combining a thermal cutout with a fuse. This means they can be used in a size close to the actual running current of the motor because they will not open on the motor starting current.

Ordinary fuses or circuit protection devices—because they lack sufficient time-lag, must be installed oversize to prevent their opening on the motor starting current. They can give only short-circuit protection to the wiring. They cannot operate to protect either the motor or the starter until the current flowing is far in excess of the motor-running current.

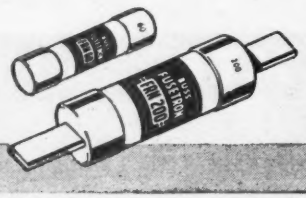
But when Fusetrons of proper size are used, any current dangerously in excess of the normal motor-running current will cause them to open. Thus they back up the overload device already installed. They double the protection the motor has against burnout.

● *Provide simplest way to prevent damage from Single Phasing*

When single phasing occurs, the current flowing through the motor and through the Fusetron in the remaining phase increases about 100%. (Theoretically 73% but change in efficiency and power factor make it about 100%).

This 100% overload on Fusetrons of motor-running protection size opens them and stops the flow of current.

So to be DOUBLY SURE that motors won't be lost should single phasing occur, just replace fuses used for short-circuit protection with Fusetrons of a size near to the actual running current of the motor.



BUSS

HERE'S PROOF

Records of Joslyn Mfg. & Sy. Co., Chicago, show that . . .

Fusetrons PREVENT MOTOR BURNOUTS

"In our plant we have 710 motors, ranging in size from 1/60th to 450 h. p. Before 1938, we used renewable fuses in all circuits, with thermal relays for individual motor protection.

"Beginning in 1938, we changed all our fuses to Fusetrons, using regular fuse sizes in mains and feeders and motor protection sizes in the motor circuits. Our records show that for the 12 months ending August 31, 1945, we had only two motor burnouts, both on the same motor. This is a 2 horsepower motor driving an electric hoist with an actual load of about 3 horsepower. Therefore, we are unable to operate the motor if we use the correct size Fusetron to protect it, and since we have been unable to get a 3 horsepower motor to replace it, due to mechanical features, the only thing we could do was let this motor run overloaded and eventually burn out.

"Our Electrical Department keeps a complete record on blown Fusetrons, giving full details on each blow, with a place for remarks by the maintenance man who makes the replacement. These records show that for the month of August, 1945, we blew 63 Fusetrons, ranging in size from 2-¼ ampere to 100 ampere, representing 43 shutdowns. From the remarks made by the maintenance men on their reports, it seems likely that probably half of these shutdowns would have resulted in burned out motors had the Fusetrons not blown."

Peter Joyce, Chief Electrician,
Joslyn Manufacturing & Supply Co.,
Chicago, Illinois

What is the FUSETRON?

The Fusetron is a DUAL element device—A Fuse to which is added a Thermal Cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories approval for both motor-running and circuit-protection as the most expensive devices made. Fit standard fuse blocks.

Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.

They are obtainable in all sizes from 1/10 to 600 ampere—in both 250 and 600 volt types.

Also obtainable in plug type and Tamper-resisting type (Fustats) for 125 volt circuits.

Their Cost is Surprisingly Low.

Fusetrons Protect Against Work Stoppage in Many Ways if Installed Throughout the Entire Electrical System

★ ***Entirely wipe out needless blows caused by motor starting currents or other harmless overloads***

Fusetrons have tremendous time-lag. They hold 500% load more than ten seconds whereas most sizes of ordinary fuses blow in less than one second. They won't open on starting currents or harmless overloads (heavy overloads for a short time or light overloads for a longer time). Fusetrons won't shut down a circuit needlessly.

★ ***Give thermal protection to panelboards and switches***

The thermal cutout in Fusetrons opens at 280° F. Thus if poor contact heat develops from any cause, the circuit is opened and heating stopped before damage can be done.

Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

Fusetrons warn that maintenance is needed instead of permitting panel or switch to be damaged by poor contact.

★ ***Prevent needless blows caused by heating in panels and switches***

Fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat than any fuses. They eliminate useless shutdowns caused by fuses running too hot.

★ ***Permit use of larger motors or adding more motors on circuit WITHOUT installing larger switch or panel***

The operating load on Fusetrons can be close to their ampere rating because Fusetrons hold starting currents—but ordinary fuses must be installed oversize because they lack sufficient time-lag to hold starting currents.

By replacing oversize fuses with Fusetrons, you can load panels or switches near their capacity. A larger motor or additional motors can be installed without the trouble or expense of changing the panel or switch.

★ ***On new installations, use Proper size switches and panels instead of oversize***

With ordinary fuses, switches and panels must be oversize because fuses larger than the operating load must be used to hold starting currents.

But Fusetrons hold starting currents, therefore, PROPER size switches and panels to fit the load can be installed, saving money and space.

★ ***Double burnout protection for large motors*** *(See opposite page)*

★ ***Make protection of SMALL motors simple and inexpensive***

Install a Fusetron of proper size anywhere in the circuit to handle ONLY the motor current—that's ALL—to safeguard against trouble and cost and lost work caused by the burnout of even a SMALL MOTOR.

★ ***Protect coils, transformers and solenoids against burnout***

Install a proper size Fusetron. It won't open on harmless overloads or normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

GET ALL THE FACTS

Get Better Protection—Send The Coupon Now

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses. Change over the whole plant to Fusetrons.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.

846

Bussmann Mfg. Co. University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

Name_____

Title_____

Company_____

Address_____

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FUSETRONS

SOLD THROUGH WHOLESALERS

Stop that Glare

Day-Brite fluorescent fixtures are optically engineered to make seeing comfortable... In the VIZ-AID, patented V-shaped ALZAK louvres evenly distribute glareless light.

The VIZ-AID

For ceiling or suspension mounting—unit or continuous installation. Designed for two 40-watt lamps. U. S. Patent Nos. D-138990, D-143641 —others pending.

Day-Brite Lighting, Inc., 5401 Bulwer Avenue, St. Louis 7, Mo.

Nationally distributed through leading electrical supply houses.

In Canada: address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6 Ont.

13

IT'S EASY TO SEE WHEN IT'S

DAY-BRITE

Lighting

Modern Lighting

Modern Lighting Equipment

Accuracy, alertness and clerical speed of employees working in the recently modernized San Francisco headquarters of the Folger Coffee Company definitely improved when high level illumination and color replaced the formerly existent sombreness of this large commercial office.

Inadequate general illumination previously emanated from a few widely spaced, hanging translucent spheres containing high wattage incandescent lamps (Fig. 1). Source brightness produced a definite glare factor although the mounting height prevented effective light concentrating on the working planes. Large unshaded windows, occupying an entire wall, admitted natural light which varied with daily and seasonal climatic changes and promoted an extreme lighting differential between the desk surfaces nearest this exterior lighting source and those desks bordering the opposite wall. Local light was provided on some work areas by desk lamps connected by stray cords to random floor outlets. Dark ceilings, beams and columns absorbed practically the entire upward component of fixture output.

The American Electrical Construction Company was employed to install modern lighting under the engineering supervision of A. Anderberg, Pacific Gas and Electric Company (Fig. 2). Indirect-direct U. R. C. pendant type fixtures were selected to provide a uniform lighting intensity of 40 foot-candles at desk levels. Four 40-watt T-12 white fluorescent lamps are contained in each of the 75 four-foot fixtures. Open top construction permits unhampered lighting of the ceiling while ceramically treated side and bottom ribbed-glass panels contribute to an even diffusion of soft illumination. Fixtures are spaced on approximate 8-foot centers in either direction and suspended 3 feet below the 16½-foot ceiling.

The present decorative treatment utilizes a neutral tint acoustical ceiling which augments the high reflectivity of columns and walls. Venetian blinds shield employees from direct exterior glare and tend to redirect overhead light back towards working areas. A utilization factor of 44 percent is obtained in this 4,400 square foot office.

Problems Breed Effective Lighting

As part of an $800,000 alteration program to "The House that Ruth Built", President Larry MacPhail, Dan Topping and Del Webb, owners of the New York American League Baseball Yankees, approved the inclusion of a "Stadium Club" for sports fans purchasing stadium boxes for the season. The club, first of its kind to be installed in an American baseball stadium, is located at mezzanine level in the grandstand, is modernly decorated with sports-flavored murals and ceiling motifs, and is indirectly illuminated by the liberal application of cove lighting.

In planning the club, lighting and decorating engineers were faced with the problems of low headroom, large reinforced concrete overhead beams and a scarcity of essential electrical and building materials.

The first contemplated treatment of hanging a suspended ceiling below the beams and employing fluorescent fixtures was discarded due to the resultant low overhead and the lack of fluorescent ballasts.

The solution proved ingenious and effective. The lower half of the beams were faced with wide finished boards to give the impression of medium sized timbers and the upper sections of the beams were rounded into the ceiling by the use of plaster to form deep, graceful coffers. Between the beams, plywood panels, undersides decorated with football and baseball motifs in relief, were suspended flush with the lowest level of the beams. Vertical borders on the

FIG. 1. Widely spaced suspended fixtures utilizing high wattage lamps in translucent bowls provided inadequate general illumination. Source brightness was accentuated by the dark, light-absorbing treatment of walls, columns and ceiling.

FIG. 2. An atmosphere of restful spaciousness is created by the installation of indirect-direct URC fixtures, each inclosing four 40-watt white fluorescent tubes. High level color toning, acoustical ceiling and venetian blinds add to the overall effect.

McGILL
LAMP GUARDS

PROVIDE

PROTECTION AGAINST BREAKAGE
PREVENTION AGAINST REMOVAL
ASSURANCE OF LONGER LIFE

FOR YOUR LAMPS

Designed for industrial, commercial and home uses, these guards are supplied in all sizes for regular or mill-type lamps, providing complete overall protection.

3 DURABLE MODELS

LOXON

LOXON — No. 1425 Lamp Guard, designed by McGill, locks on preventing unauthorized removal and breakage of lamps. Constructed with steel wire heavily tinned; available in sizes to fit all sockets, as well as regular and mill-type lamps. Used in garages, factories, yards, shops, basements, etc.

GRIPON

GRIPON — No. 1600 Non-Locking Guard prevents breakage and is similar in construction to the Loxon Guard except plain steel screws are used instead of locking screws. Easily detached for lamp renewal. Made to stand hard use, and for both regular and mill-type lamps.

PROTECTOR "O"

PROTECTOR "O" — No. 14333 Heavy Duty Guards for general construction work. Will stand hard use and abuse. Can be easily moved when required, from one job to another. Made of No. 10 steel wire, heavily tinned to prevent corrosion. The collar slips over weather-proof sockets generally used on outside work.

SEND FOR CATALOG

Electrical Specialties Catalog No. 43 giving full details, or ask your Wholesaler for McGill Products.

McGILL MANUFACTURING COMPANY, INC.
Electrical Division VALPARAISO, INDIANA

Low wattage, closely spaced, concealed incandescent lamps are located in suspended plywood panels and behind wall valances to direct soft, even illumination towards ceiling and paneled walls. Wall murals and ceiling motifs carry out the sports atmosphere which typifies the purpose of the stadium. Color and light are blended to create stimulating, though not harsh, effects.

panels formed large, shallow open-topped boxes in which were installed continuous border series of incandescent lamp receptacles on 6-inch centers, holding 15-watt lamps. The use of these closely spaced, low wattage lamps throws an even light up into the ceiling bays. False-beam valances were installed along the walls and series of 15-watt incandescent lamps, likewise spaced at 6-inch intervals, were used to softly illuminate the paneled walls.

The resultant treatment, born through a lack of desired materials, creates a rich, soft envisionment and again demonstrates that incandescent lamps can be used modernly and effectively. The warm tones of the resultant illumination are very often desirable.

In addition to the "Stadium Club", a second lounge serves the press. For those reporters who wish to keep papers from blowing while they write, an audio connection with the press box amplifies the play-by-play progress of the game. Utility outlets provide means for augmenting the general illumination through the use of supplemental desk or floor lamps.

The popular appeal of the Club was attested by a pre-season membership of 400 which includes on its roster a cross section of the Who's Who from business, finance, politics, the theater and sports world.

The lighting installation was by electrical contractors Fischbach and Moore who also installed the extensive wiring in conjunction with the Yankee Stadium floodlighting project.

Fundamentals of Store Lighting

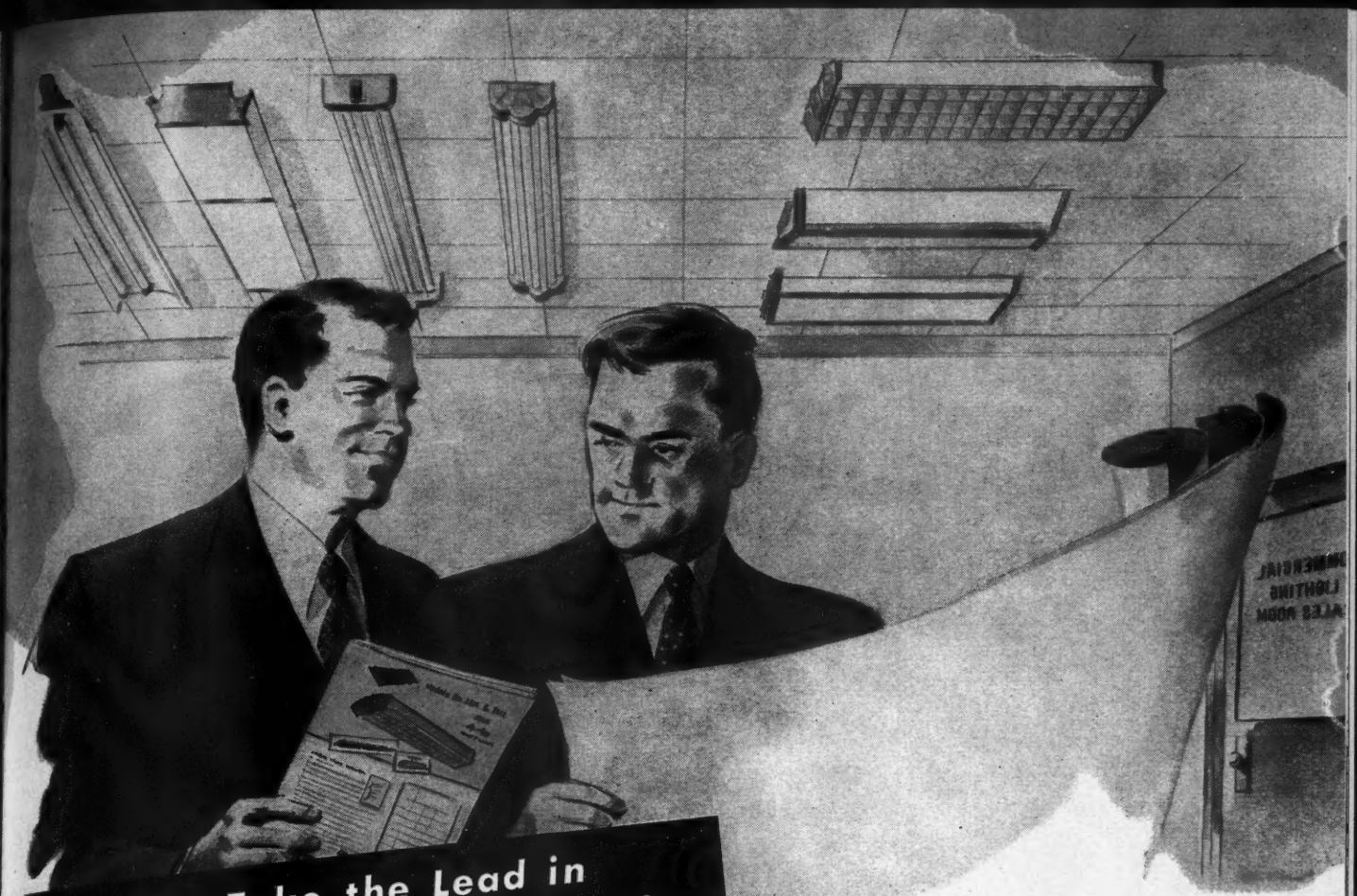
By H. W. BRAUN
Lighting Engineer, Lighting Division
Westinghouse Electric Corporation
Cleveland, Ohio

Lighting is an important feature of store design. It can be used as an aid to selling. Well planned lighting will sell merchandise, as well as the store itself. Instead of letting a customer look for an item, good lighting will point it out.

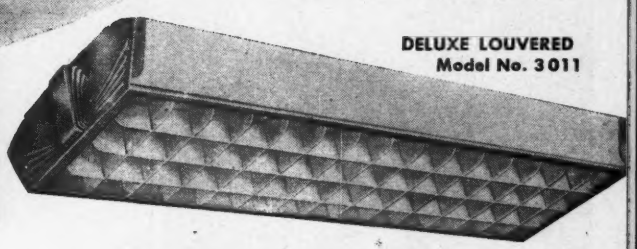
Whether a customer buys or not depends on the clarity with which he sees the merchandise. Four factors are involved in seeing; time, contrast, size and brightness.

Time—The fast pace of the buying public demands that displays be seen quickly and accurately. Detail can be distinguished, even under low levels of illumination, if sufficient time is given. The progressive merchant, however, will make it easy for the customer to see quickly, and with ease. Otherwise, the customer passes on and a potential sale is lost.

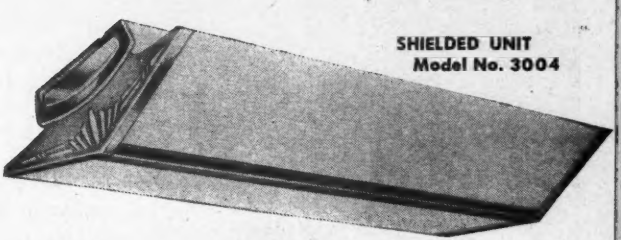
Contrast—It is more difficult to see a black object against a grey background than against a white background. An increase in illumination on the background increases the contrast, and the seeing task is made easier. Consequently, in display work there should be high contrasts between the setting and the display goods, accomplished by high lighting the displays, using color for back-



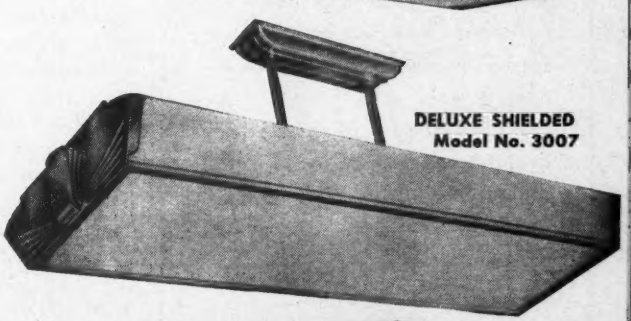
You Take the Lead in Commercial Lighting Service with the New Complete MITCHELL LINE



DELUXE LOUVERED
Model No. 3011



SHIELDED UNIT
Model No. 3004



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Illustrates and describes the complete line of Commercial Luminaires. Includes helpful lighting data and servicing information. Write for it now.

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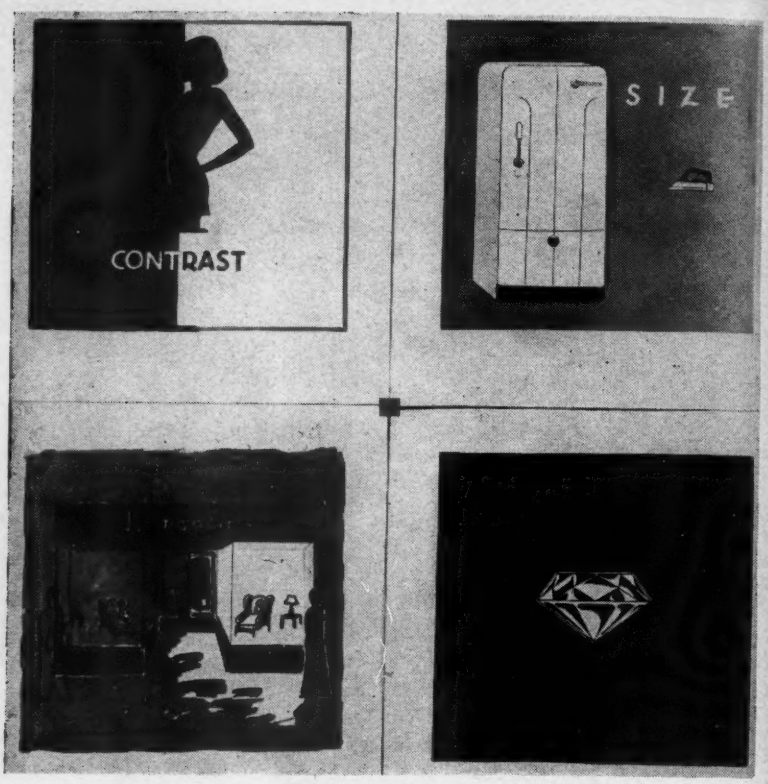

FIG. 1—The clarity with which a potential customer views store merchandise depends on four factors: contrast, size, time, and brightness.

ground, or by a combination of both.

Size—The larger an object is, the easier it can be seen. When large objects, such as refrigerators, are displayed, the illumination need not be as great as that for the display of small objects, or of paintings, for example, where the seeing detail is important.

Brightness—Since the only light that is seen is light reflected to the retina of the eye, a white object that reflects 80 percent of the light rays striking it will be more outstanding than a grey object that reflects only 20 percent of the rays. To have the same brightness, the latter would need four times the illumination.

Brightness can be controlled to a greater degree than any of the other factors. By proper illumination it is possible to compensate for size, contrast and time. Brightness causes glare and eye fatigue when wide variations are reflected to the eye. Low variations make seeing difficult and slow. It is for these reasons that lighting levels must be studied and proper brightness ratios maintained.

Types of Stores—In planning a store lighting system, an analysis should be made of what it must accomplish. Stores may be classified according to the buying habits of the public, which are identified simply as follows:

1. Buying frequent needs
2. Buying periodical needs
3. Buying luxury needs

Color—The principal uses of colored light are summarized as follows: it helps create the proper background atmosphere; it attracts attention; it enhances appearance.

Care must be exercised when using colored lighting for feature displays so as not to distort the true color of the merchandise, especially clothing. Use of colored lighting on a background with white light on the feature display is an excellent way of obtaining contrast and attention. Use of blue and green suggest coolness, and of amber or red suggest warmth.

In order to plan for color lighting effectively, relationships of its intensity and effectiveness with white lighting should be known and understood. Table I gives such relationship for blue, green, red and amber—in comparison with white light.

The fluorescent lamp offers the most efficient means of obtaining colored lighting because it produces color direct, and not by a subtractive method, as is the case with filament lamps.

The spectrum of fluorescent "white" lamps are rich in blue, yellow and green. Because colors have been viewed under filament lamps for so long, some colors will appear slightly different under fluorescent lighting. This should be taken into consideration in designing the painting scheme, and in the display of merchandise. Paint, furnishings and decorations should be selected under the color of light which will normally be used. Table II offers a guide to the effect of certain colors commonly used when lighted with fluorescent lamps of various types, as well as with filament lamps.

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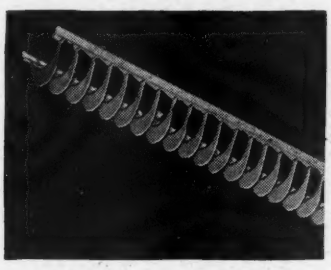
Light Diffuser for Fluorescent Lamps!

No glare—greater efficiency.
Does not cast shadows.



Made of lightweight aluminum, finished in white baked enamel.

. . . means improved lighting for factories, offices and stores

Fluor-O-Shields afford keener visibility by eliminating glare, minimizing stroboscopic effect, diffusing evenly and softening the light of fluorescent lamps. Better lighting means more efficient work, more sales and improved conditions for store displays, office layouts and production lines.

In exactly 2 seconds you can mount a Fluor-O-Shield (2 sizes) on either a 40 watt or 20 watt fluorescent lamp. Fluor-O-Shields fit practically all exposed lamp fluorescent fixtures—single or multiple lamp units. Snap-on clips permit instant mounting without screws, bolts, or tools. Complete offices, stores and factories can be equipped with Fluor-O-Shields in a surprisingly short time.

Suitable for continuous or unit mounting. Made of lightweight aluminum, finished in white baked enamel. Fluor-O-Shields cause no stress or strain on lamps, sockets or fixtures. If your distributor does not stock Fluor-O-Shields, write us for name of distributor who can supply you, or ask your distributor to write us.

- **Eliminates Glare. Diffuses Light Evenly**
- **For Factory, Office, Store, Home Lighting**
- **Fits Nearly All Open-Face Fluorescent Fixtures**
- **Practical. Inexpensive. Decorative**

SPECIFICATIONS

Cat. No.	Length	Fits Lamp	Units Per Pkg.
27-1-40	46⅞ in.	40 watt	12
27-5-40	22⅞ in.	20 watt	12

$1.95 40 watt 46⅞ in. **$1.25** 20 watt 22⅞ in.

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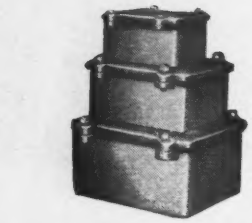
Junction Pylets

THICK WALL—
WEATHERPROOF



These heavy-duty Junction Pylets are built to withstand severe service conditions, and are furnished complete with overlapping gasketed covers held in place with slotted hexagon cap screws. These boxes are available in a full range of standard sizes up to 26x18x8 inches, and can be furnished drilled or tapped for conduit as specified.

Junction Pylets also available—Flush Type with cover screws inside; Hinged cover type; and Threaded cover type.

Refer to your Pylet Catalog for complete listings.

THE PYLE-NATIONAL COMPANY
1344 N. Kostner Avenue, Chicago 51, Illinois

General Lighting—There are no hard and fast rules for the lighting of sales areas, but the following are considered of fundamental importance:

1. The general lighting plan should tie in with the architectural treatment of the area.
2. The footcandle level should be in the range of 35 to 70, depending on location and treatment of the area.
3. The lighting equipment should be attractive but unobtrusive—the customer's attention should be focused on the displays, not on the overhead lighting.
4. Glare from the light source should be avoided.

Specialized Lighting—Show windows, showcases, wall cases and free-standing displays require specialized lighting. High intensities in show windows are necessary to combat daylight reflections. Color in windows attracts added attention, and is more effective at night. Locality, background and type of displays control illumination levels. Flexible window lighting layouts aid in meeting these variable problems.

Show and wall case lighting should be approximately double general lighting levels. Lighting equipment should be small and inconspicuous, and well concealed. Free-standing displays should be approximately four times as bright as the general background lighting, with spotlights adequately hidden.

TABLE I

COMPARISON BETWEEN WHITE AND COLORED LIGHTING

Color	For Equal Intensity	For Equal Effectiveness
White	1	1
Amber	2	1.5
Red	10	3
Green	12	5
Blue	30	7

Check Points—With lighting playing a more and more important part in today's merchandising, the owner and lighting engineer should analyze the lighting layout to see if it will accomplish the following:

1. Is there sufficient light for the older customers with poorer eyes to see the merchandise with ease and clarity?
2. Will the lighting provide light that will display the merchandise to its best advantage?
3. Will the impulse items be seen quickly?
4. Will the chosen design be appropriate to the general store design and its locality?
5. Will the luminaires be easy to maintain?
6. Will the lighting design attract attention and increase sales?

TABLE II

EFFECT OF FLUORESCENT LIGHTING ON WALL COLORS

Color of Plant Tested	Daylight Mazda F	White Mazda F	Soft White Mazda F	Filament 100 Watt
Cascade Blue (Pastel)	Bluish Green (Preferred)	Greyish Green	Slightly Greyish	Yellowish Faded Blue
Bluish Green				
Palmetto Green (Pastel)	Fresh Blue Green (Preferred)	Yellowish Grey	Slightly Greyish	Yellowish Pale Green
Yellowish Green				
Peach (Pastel)	Good—Slightly Pink	Normal Slightly Cold	Normal Slightly Pinkish	Normal Same as White
Blossom Pink (Pale)	Purplish Pink	Yellowish	Intensified Normal Pink	Yellowish
Maize Tan (Pastel)	Greyish-Cold	Yellowish	Cream—Good	Strongly Yellow
Sun Tone (Cream)	Faded Grey	Slightly Greenish	Cream—Good	Cream—Good
Deep Cream (Williamsburg)	Bluish—Excellent	Intensified —Good	Slightly Grey—Good	Yellowish—Fair
Governor's Red (Williamsburg)	Slightly Bluish—Good	Yellowish—Good	Warmer—Good	Yellowish—Good
Deep Blue (Williamsburg)	Vivid—Good	Richer—Good	Vivid Blue (Preferred)	Greyish
Dusky Rose	Bluish	Yellowish	Vivid—(Preferred)	Yellowish
Deep Yellow	Greyish—Unattractive	Vivid	Slightly Grey—Good	Reddish

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WITH PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT

MODERN LIGHTING CONCEPTS combine beauty, utility and efficiency. When you show your customers how *Pittsburgh Permaflector* Lighting Equipment gives them all this—plus unusual flexibility of application . . . they too will agree *Pittsburgh Permaflector* is a "must" in their new building and remodernization programs.

PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT is a *complete* line offering many sales advantages. There is a *Permaflector* for *every* purpose—interior and exterior . . . commercial, institutional and industrial.

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Elect. Contr.: Wood Elect. Construction Co.

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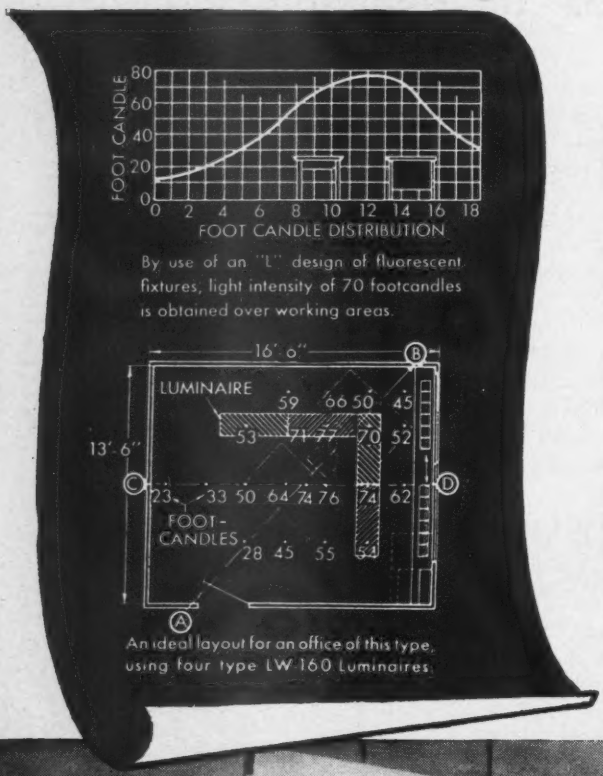


puts extra light

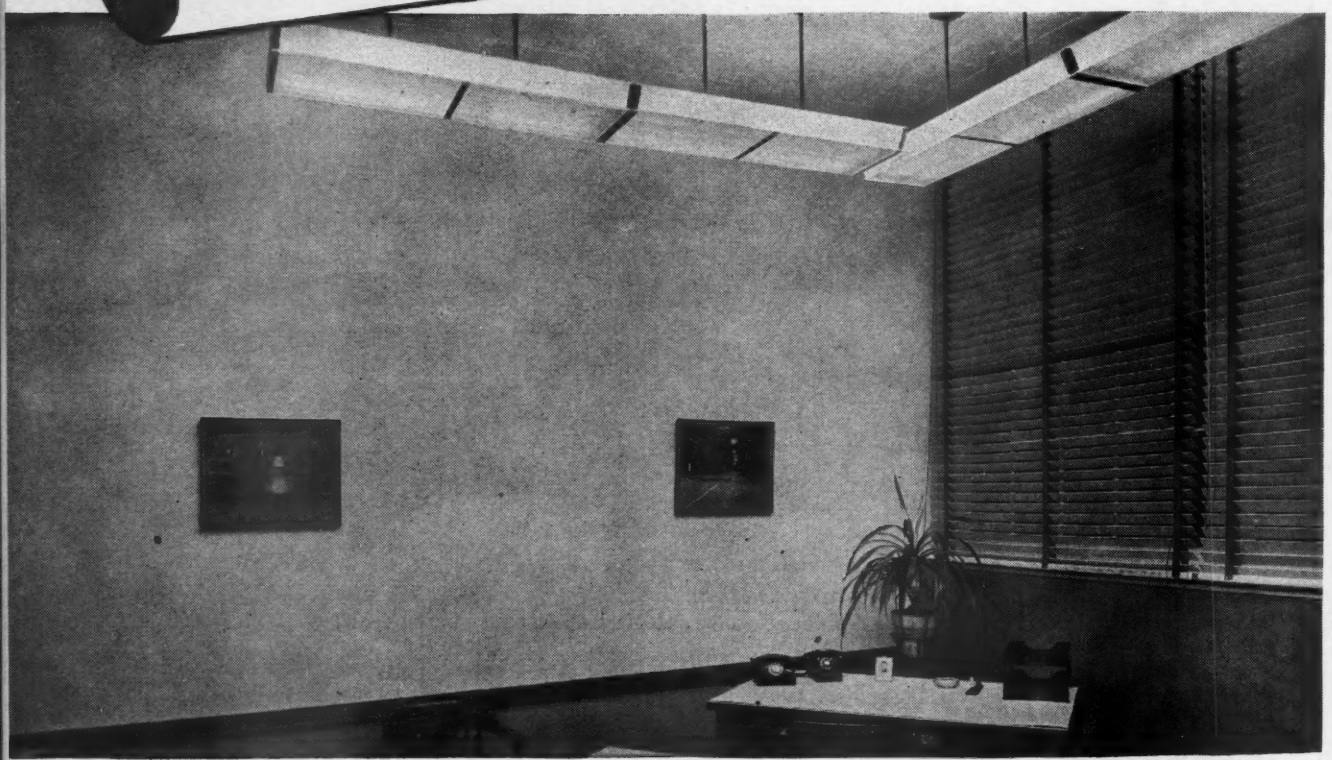
where the work is done . .

This new Westinghouse development in private office lighting grew out of a simple yet scientific approach—*provide maximum seeing comfort for the person working at desk or table.*

Why sacrifice seeing efficiency over main work areas for symmetry of fixtures—when little else in an office is symmetrical—or for "average illumination" in unused corners?

Functional lighting will help you sell better and more satisfactory office lighting jobs. Installation is not complicated. It merely involves locating standard fluorescent fixtures around, but not in front of, the person working at desk or table—for higher light intensities and elimination of reflected glare.

A Westinghouse Lighting Specialist will be glad to work with you on specific applications. Just phone your nearby Westinghouse office. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-04092-B



Westinghouse

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PLANNED LIGHTING

AVAILABLE THROUGH 127 WESTINGHOUSE ELECTRIC SUPPLY OFFICES AND INDEPENDENT JOBBERS

Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Aluminum Tubing

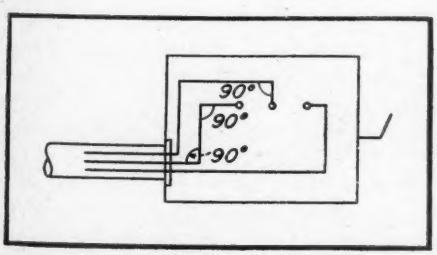
Q. *We are unable to obtain either rigid conduit or thin wall for a job we have and would like to make use of some aluminum tubing which seems to be similar in size and wall thickness with regular thin wall conduit. Will the use of this aluminum tubing be contrary to the Code?*—L.C.M.

A. The Aluminum Company of America manufactures both rigid conduit and electrical metallic tubing and have Underwriters' Laboratories approval on both, so if either is used it will comply with Code requirements.—G.R.

Deflection of Conductors

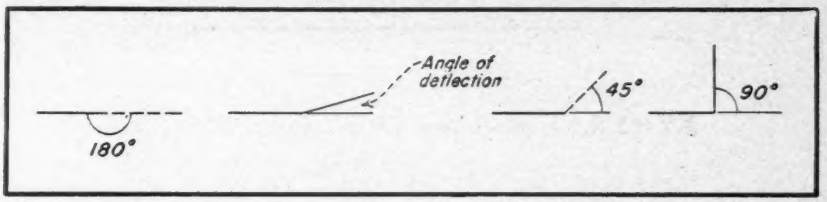
Q. *Section 3012b of article 300 states "where underground conductors of No. 1 or larger are deflected more than 30° where entering a raceway in a cabinet, pull box, junction box or auxiliary gutter, the conductors shall be protected, etc."*

Is 90° more than 30°? What is the correct interpretation of this section?" —E.W.



A. If a wire is carried straight into a box and is not bent at all, it lies in a straight line or in a straight angle or at an angle of 180°.

If a wire is bent from this straight line, the deflection or angle of deflection is measured by the angle through which the wire is bent away from this straight line as shown. It is not measured by the angle away from the right angle as indicated in the question.



Too much stress cannot be placed on the requirement for insulating bushings as required by Section 3012 as many conductor failures are occurring and quite often fires result.—F.N.M.S.

Fluorescent Fixtures

Q. *In a relighting job in which plug-in type fluorescent fixtures were hung, the electrical inspector has refused to O.K. the job because I connected the fixtures to screw-shell receptacles. Is this a Code violation?*—W.F.C.

A. Yes, the inspector no doubt had reference to Section 4165 of the N. E. Code, which reads as follows: "Receptacles of the screw-shell type shall be installed only for use as lamp holders."—G.R.

Overcurrent Protection

Q. *We plan to produce motor operated equipment which may utilize as many as four one-fourth horsepower or smaller 105 volt motors. These motors will contain integral overcurrent devices and will be automatic in their operation. Will each motor have to be supplied by individual circuit overcurrent protection, or may they be supplied by a single circuit provided with a single overcurrent device?*—E.R.

A. Under Section 4343 of the N. E. Code you will find permission to use a single circuit provided with a single motor circuit overcurrent device for these motors providing the motors are protected by approved motor runnin protective devices. Under Section 433 you will note that the motor circu overcurrent protective device cannot b rated at over four times the rating of th smallest motor of the group unless th running overcurrent devices attache to each motor are approved for grou installation and are marked to indica the maximum size of fuse or breaker b which they must be protected. Th precaution is necessary as the usu thermal relay or cutout used for moto overcurrent running protection is n suitable for opening short circuits.—G.R

125 Volt Switch on 220 Volts

Q. *Conventional storage wat heaters are wired for 220 v connection. Many electrical inspecto accept 125 volt switches with 125 v Edison base fuses. Does this satisfy t 1940 edition of the Code?*—E.S.

A. No. As the voltage between t blades of the switch must be the 250 volt rating with spacings for 2 volts.

If the supply system has a ground neutral and the ungrounded conducto are at 125 volts to ground, the 125 v plug fuses may be used as is permitt by the second sentence of Section 24 —F.N.M.S.

Hazardous Locations

Q. *An addition is being construct to a paint manufacturing pla and I plan to enter a bid on the el trical installation. The question of wh*

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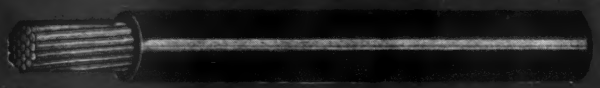
Makes A Complete Line Of

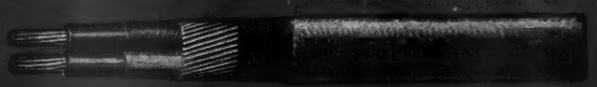
ELECTRICAL WIRES AND CABLES

CRESCORD . Jacketed Portable Cord

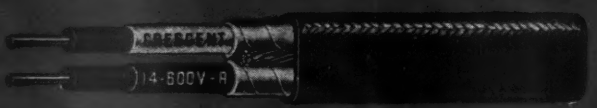


SYNTHOL Building Wire • Types T & TW

Rubber Covered Building Wire and Cable



Service Cable • Types SE-U; SE-A; SD



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AND AMONG OTHER TYPES THE FOLLOWING:

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Signal Cable
Slow-burning Wire & Cable
Switchboard Wire & Cable
Telephone Wire & Cable
Thermostat Cable
Trench Cable
Varnished Cambric Cable
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TRENTON, N. J.

areas are hazardous has come up and there is some doubt as to how this must be determined. This plant will produce an exterior paint in this new addition using linseed oil and turpentine as the only liquids. Will a room or building in which either or both of these liquids are used in open mixing vats be considered a hazardous location?

A. A volatile flammable liquid which has a flash point below the maximum ambient temperature of the room or building in which it is handled should always be considered as hazardous liquid and such rooms or buildings should be wired in accordance with Article 500 of the N. E. Code. The flash point of turpentine varies from 90 to 95 degrees fahrenheit, so this is a borderline case. Without a doubt there are areas where maximum room temperatures may never exceed 90 degrees fahrenheit; however, if there is any possibility of the room temperature exceeding the flash point, wiring within the room should be of the type approved for Class 1 Group D locations. In addition, consideration should also be given the possibility of changes in products or their ingredients in plants manufacturing products such as paints as lower flash liquids might be used at some future time.—G.R.

Type T Conductors

Q. *The local ordinance requires all-metal raceways, and the only conductor we can obtain for a motor feeder circuit is Type T. Load will require that we use 500,000 circular mil conductors, but we understand that they are not approved. Is that true?*—C.W.B.

A. The present Code does not recognize Type T conductors in sizes larger than 4/0, therefore the larger sizes have not been approved. The 1946 Code will recognize this type of conductor in sizes up to 2,000,000 circular mills, but will require that all Type T conductors larger than 4/0 be run in free air. Therefore the use of 500,000 circular mil Type T within a conduit will not be permitted by either the present or new edition of the Code. This obstacle might be overcome by using in parallel 3/0 Type T conductors. —G.R.

Romex in Concrete Wall

Q. *Does the Code permit the fishing of Romex within hollow spaces in a concrete block wall?*—J.A.L.

Mr. H. H. Lundberg says it's Easy

"IT'S A ONE MAN JOB"

INTERCHANGEABLE GLASS PANELS EGGCRATE OR HONEYCOMB LOUVRE
LOUVRES FOR HEAT DISSIPATION
TWO WING NUTS HOLDING WIRED COMPLETE REFLECTOR
PIANO-HINGED
INNER FRAME CLIP HOLDER FOR GLASS PANEL OR METAL LOUVRE
QUICK SLIDING CATCHES
SELF-ALIGNING LEVEL MOUNTING CLIP

10 F.C.

25 F.C.

50 F.C.

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"In the work of transforming and rehabilitating this old warehouse so that it will house modern offices (as shown in the photographs), we found the All-Bright REC fluorescent fixtures highly desirable. Thanks to the great flexibility and simplicity of installation of these recessed lighting fixtures, the labor involved, was greatly reduced. Lighting engineers will be interested to know that our light volume was increased from 25 foot candles to 50. F.C. These fixtures are so designed as to provide many features facilitating the contractor's installation job. In this work we had the whole-hearted and valuable cooperation of Wadeford Electric and All-Bright engineers."

N. N. Lundberg

Wadeford Electric

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ALL-BRIGHT ELECTRIC PRODUCTS COMPANY

Manufacturers of Fluorescent Lighting Fixtures

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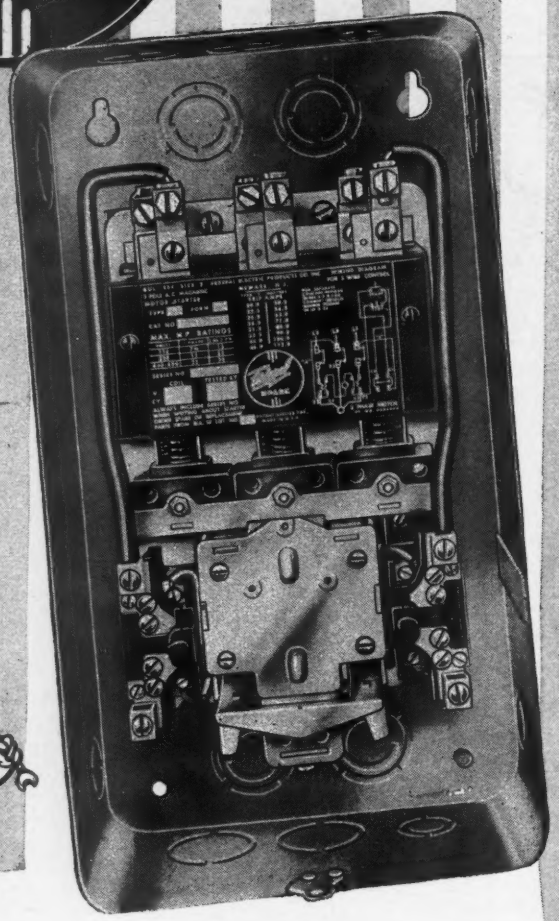
MAGNETIC
MOTOR STARTER



For man-size jobs of stop-and-go
Without a bit of care or woe
This starter really fills the bill . . .
A fine example of Federal's skill!

Sets a new standard of ease and speed in replacement of any stationary or moveable contacts. Coil replacement in a few seconds without disturbing line or load connections. Greater compactness, yet more ample wiring space. Silver contacts on all current interrupting points. Exclusive vertical ball-bearing operation for highest speed solenoid action. Overload relays, combination hand or automatic reset, for dependable protection.

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A. The 1940 edition of the Code does not contain permission to fish nonmetallic sheathed cable within the air voids of a concrete block or tile wall, but the 1946 edition will provided the wall in question is not subject to excessive moisture or dampness. That will result in some confusion as to when a wall is to be considered damp as most concrete block and many clay tile walls subject to weather exposure have a rather poor resistance to moisture seepage. A concrete block wall even when painted is rated as a poor moisture barrier. This will make it necessary to obtain an official interpretation; however, it is my individual belief that an exterior block or tile wall should not contain this cable within the air voids unless the wall has an outside facing of some type of building material having a good resistance to moisture penetration. —G.R.

Junction Boxes

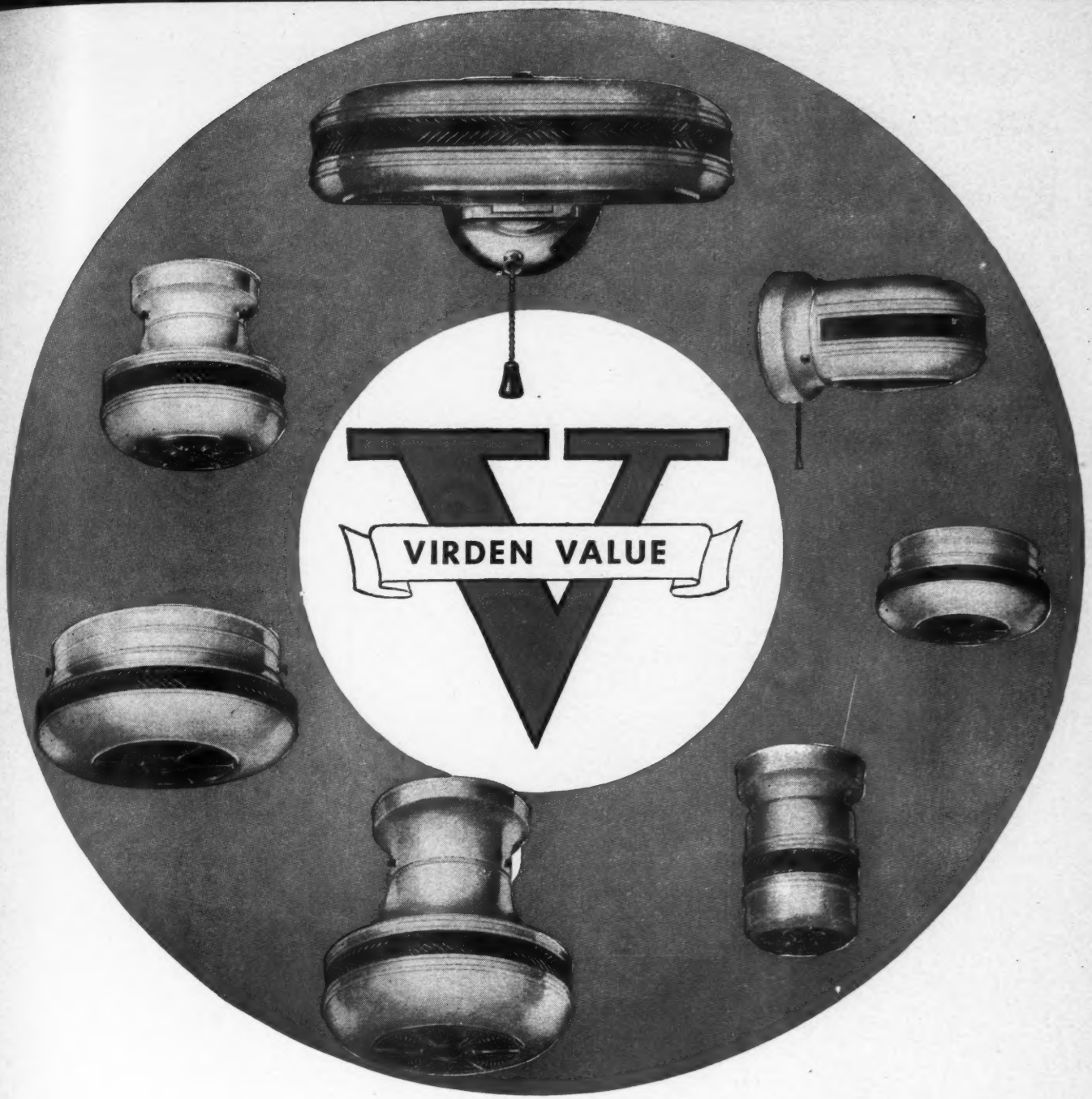
Q. *Rule 3713 says that all junction boxes are to be accessible. Is it consistent with the intent of the Code to install ordinary outlet boxes in attics of a new building where to reach same it is necessary after the completion of the building to crawl to said outlet on hands and knees or in other words where the location is difficult to reach?*—E.S.

A. The intent of the Code is that junction boxes shall be located where they may be reached thus admitting close approach. Having to crawl on hands and knees to reach junction boxes would not find favor with all inspection departments, but having to stoop or crouch would not be too hard for an active inspector.—F.N.M.S.

Emergency Lighting

Q. *We are about to wire a new theatre building, and the specifications call for special emergency lighting and illuminated exit signs. There is only one source of power available within a reasonable distance from this building. Does the Code make it mandatory for us to install batteries or an automatically operated generator to furnish current for this emergency lighting?*—C.B.

A. The Code under Section 7011 provides for several means of supplying emergency lighting circuits, and in addition to the two methods mentioned in your question, you may use a second service from the same distribution system if that is the only one avail-



In Good Taste for Bathroom and Kitchen

● You can provide any bathroom or kitchen with good lighting by using these interesting "Virden Value" fixtures—shown in our current catalog.

Smartly simple, with brilliant chromium plated steel holders, and enamel sprayed glass with crystal highlights of rich beauty. Easy to see that they're strictly in good taste for any home.

Just as easy to discover that they are strictly Virden Value—beating the world to the punch on the basis of dollar-and-cent economics.

Virden jobbers can supply them promptly.

The John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute

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BOOK OF HOMES
HOMES
Better Homes
HOUSE BEAUTIFUL
House
Garden
The Story of Electromode all-electric Home Heating reaches the prospective home-builders of these National Magazines through regular advertising.
Today's Heating System
Without a Furnace
- Amazing, clean, safe electric heat
Home builders have indicated great interest in "heating by wire" and Electromode All-Electric Heaters, styled for domestic use, are now in regular production to meet the increasing demand. Here are a few interesting reasons why home-heating electrically, with Electromodes, deserves this growing popularity:—
•No basement or central heating unit required.
•No storage space for fuel, no smoke, odors, dirt, or ashes.
•Electromode Room Heaters, wall-installed, take up no floor space.
•No glowing hot wires.
•Utmost economy—no power consumption except when actually in use.
•Thermostatically controlled, individually or in groups.
•Heated air is circulated near floor by a motor-driven, built-in fan.
•No fire, shock or explosion hazard.
•High thermal conductivity of finned aluminum heating element.
•Same patented heating element as that used in Electromode Heaters on U. S. Submarines. Resistors are completely insulated and sheathed within the one-piece finned aluminum casting.
The patented Electromode Heating Element, used exclusively in all Electromode Heaters, has the resistors completely insulated, sheathed, and embedded in a one-piece finned aluminum casting.
Consult your power company and electrical contractor for complete installation particulars,— or write ELECTROMODE CORP.,Rochester 3, New York.
ELECTROMODE
All-Electric Built-in
ROOM HEATERS
Write for Brochure 46-D on home heating by wire.

Reproduction of recent Electromode advertisement

able or you may connect to the regular service to the building provided such connection is made ahead of the main service switch. The latter method is the one most commonly used, however, the Code does recommend that where available, separate and individual services be used for emergency lighting. You will find these provisions under Section 7011.—G.R.

Overcurrent Devices

Q. *When installing a motor feeder circuit, it is my understanding that the conductor size is determined by taking 125 percent of the full load running current of the largest motor plus the total running current rating of the rest of the motors. Now if fuses are provided which will protect such a conductor, they will open should more than one motor start at the same time. Can you advise the proper way of overcoming this problem?*—E.A.

A. In the first place, you will note under Section 4343 that where motors having full load ratings in excess of six amperes are supplied from a common feeder, the individual motors must be provided with overcurrent running protection. The overcurrent devices protecting the motor circuit are, therefore, called upon only for short circuit protection and may have a rating much greater than that of the conductors protected. You will note the proper method of determining the rating of such an overcurrent device in the example shown at the bottom of page 344 in the National Electrical Code. Should the group of motors in question consist of two or more motors of equal ratings which must be started simultaneously, it may be necessary to use larger feeders and overcurrent devices having correspondingly larger ratings. See also Section 4362.—G.R.

Rural electrical construction contractors (L to R) W. A. Patterson, W. A. Patterson Co., & I. O. Teigen, St. Paul, Minn.; C. F. Martin, Sr., and C. F. Martin, Jr., Martin Engineering Co., Fargo, N. D., discuss REA problems at recent organization meeting of the Rural Electrical Contractors Association in Chicago.

Here's what contractors are saying about G-E's New Store Lighting Meetings!

"Most contractors are considered by their customers to be authorities in electrical matters. These meetings are a good way to catch up on the latest ideas in store lighting."
(C. M. BELTZHOOVER, CINCINNATI, OHIO)

"I'm primarily a technical man . . . but it's plain to me that you don't have to be a born salesman to use G-E's method for developing new business in commercial lighting."
(EMERY GEORGE, CINCINNATI, OHIO)

"25 years at this electrical game is likely to get any man in a rut . . . but your course will do a lot to lift him out of it!"
(C. F. DUVALL, HAMILTON, OHIO)

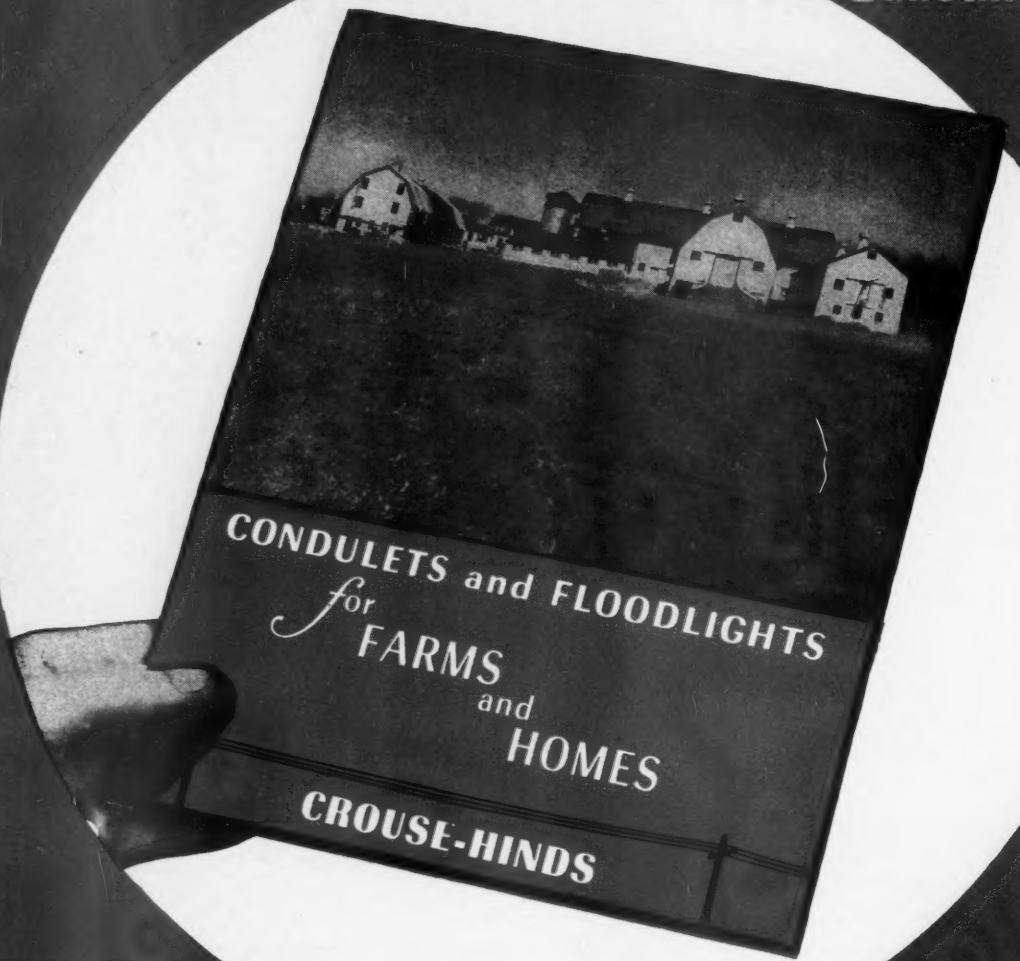
"I'm glad to learn how simply store lighting can be financed. That makes it easier to sell complete jobs, instead of piecemeal . . . and the customer can pay out of results."
(WM. SANGER, CONNEAUT, OHIO)

"Your program convinced me that I can sell more store lighting if I talk results *in terms of better merchandising instead of talking the 'nuts and bolts' of fixtures, lamps and wiring."*
(R. A. PEMBER, ASHTABULA, OHIO)

EVERYWHERE G-E's new Store Lighting Meetings have been held, they've gone over big with contractors. Why? Because these four fast-moving meetings bring you not only facts, figures and ideas that will help you locate and develop prospects—but all the booklets, sound-slide films, sales letters and other tools you'll need to *sell* more commercial lighting.

SO CALL YOUR G-E LAMP REPRESENTATIVE NOW, and arrange to participate in this valuable series of meetings when they are presented in your area. You'll find it's the most complete, practical program of its kind ever offered. And it's ready *now* to help you shoot for maximum profits from Sales Lighting for stores!

CROUSE-HINDS *New* Bulletin 2592...



. . . . will be a big help on your RURAL ELECTRIFICATION jobs

It contains approved service entrance drawings and actual photographs of rural installations, together with listings of hundreds of types and sizes of Crouse-Hinds CONDULETS, GROUNDULETS, Lighting Fixtures, and Floodlights. By using this sturdy cast-metal equipment you can put in safe, long-lasting installations that build good will and enhance your reputation for quality workmanship.

Write for your copy of Bulletin 2592.

Type F Service Entrance Cap for Conduit

Type FBM Service Entrance Cap

Type LB Service Entrance Elbow

Type FBA End Fitting

Type CGY Service Entrance Connector for Cable

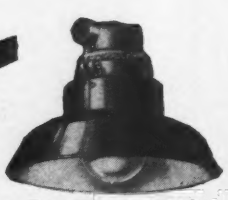
Type FEE Service Entrance Cap for Cable

Type GCH Groundulet

Type GC Grounding Strap

Type GC Bushing

Type GC Strap Clamp


Type V Vaportight Lighting Fixture with Reflector

Type MDB Floodlight

Type FSC Weathertight Plug Receptacle Condulet

Type FS Weathertight Switch Condulet

Type VRB Weathertight Lighting Condulet

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Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. *Resident Sales Engineers:* Albany — Atlanta — Charlotte — Indianapolis — New Orleans
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ELECTRONIC EQUIPMENT

1 Handbook B-3658 discusses Maintenance of industrial electronic equipment. Westinghouse Electric Corp.

COUPLINGS

2 Bulletin SL-1000-1 illustrates and describes resilient flexible couplings. Crocker-Wheeler Div. Joshua Hendry Iron Works

MACHINERY PRODUCTS

3 Booklet MTC-1245, consisting of 24 pages, features machinery products, including etchers, drills, screw drivers, grinders, hammers, tool accessories, live centers, chuck, demagnetizers, tachometers. Ideal Industries, Inc.

RADIO INTERFERENCE FILTERS

4 Bulletin SFF-100 describes and illustrates "Elim-O-Stat" radio interference filters for fluorescent lamps. Solar Manufacturing Corp.

INSTRUMENTS

5 Bulletin No. 105 provides a complete description of these new instruments for shops or laboratories. Reiner Electronics Company, Inc.

ELECTRICAL EQUIPMENT

6 Booklet B-3484, consisting of 36 pages, features electrical equipment for every phase of the petroleum industry. Westinghouse Electric Corp.

BATTERY CHARGER

7 Bulletin B-206 illustrates single-circuit, three phase battery chargers for motorized hand-lift trucks. The Electric Products Co.

ALARM SYSTEM

8 Bulletin No. U46 illustrates and describes Unilarm, a factory built unit alarm system for explosion proof, dust-tight, vaportight and general purpose. Russell & Stoll Company, Inc.

SERVICE ENTRANCE CABLE

9 An eight page catalog illustrating and describing the various kinds of service entrance cables approved by the Underwriter's Laboratories. Simplex Wire & Cable Co.

RELAYS

10 A 48-page catalog featuring relays is divided into sections for aircraft, light and heavy duty circuit control, sensitive, telephone, time delay, impulse, radio, high-frequency and keying types of relays. Leach Relay Company.

TRANSFORMERS

11 "How to Use One Bank of Transformers to Supply Two Different Loads" is the title of Bulletin TU-76. Seven typical problems are discussed. Wagner Electric Corp.

ELECTRIC TOOLS

12 Catalog 464 illustrates and describes line of electric tool equipment, including portable hammers, drills, screwdrivers, nut runners, grinders, sanders. Syntron Co.

LAMP SALES

13 More Profit from Lamps is booklet containing ideas for display and sale of lamps. The market, method for utilizing window and counter displays, and layouts for counter exhibits are included. Westinghouse Electric Corp.

PLASTICS IN LIGHT

14 Plastics for Light Conditioning is 12-page booklet describing use of plastics for reflectors and shades. All models are included with characteristics of each. General Electric Co.

FLUORESCENT FACTS

15 How to Get the Most from Fluorescent Lighting tells what to look for and what to avoid in planning a fluorescent lighting installation. A 13-point check-list is included as an aid in selecting the fixture which will produce the maximum lighting efficiency at a minimum operating and maintenance expense. Day-Brite Lighting Inc.

POWER TRANSFORMERS

16 Reference aid for reducing plant wiring costs, upkeep and maintenance is the design of Power Circuit Dry Type Transformers bulletin 461-PCT. Wiring diagrams and mounting suggestions are included with detailed table giving dimensions and data on

Circle numbers, sign and paste on your letterhead and mail in an envelope.

ELECTRICAL CONTRACTING **August**
330 West 42nd St.
New York, 18, N. Y. **(Not good after October 1)**

Please send me without obligation, manufacturers' literature herein described and identified by numbers circled below.

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43													

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SORGEL AIR-COOLED TRANSFORMERS

Have Everything

Liberal Design
For continuous hard service.

High Efficiency
Low temperature—55°.

Solderless Terminals
No splicing—No soldering—No taping.

Connection Compartment
No junction boxes or extra fittings.

Wall or Floor Mounting
No extra brackets.

15 KVA. 3-phase,
Wall Mounting Type.

Interchangeable
Single Phase Units
460 or 230 volt primary.
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Three-Phase Units
All self contained.
No complicated connections.

Sizes and Types
For every purpose.
Single phase, poly-phase, phase changing.
Insulating, Auto, Booster.
¼ to 1000 KVA.
All voltages.

Right Prices
Priced according to a fair sales policy.

50 KVA. Single phase.
Floor Mounting Type.
With cover of connection compartment removed, showing solderless terminals.

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wisconsin

Pioneers in the development and manufacturing of Air-Cooled Transformers

double wound and single wound auto type transformers. Jefferson Electric Co.

RELAYS AND TIMING

17 Catalog gives detailed information on line of standard relays and electrical timing devices. New ratings of equipment are listed in this well illustrated 24-page booklet. Potter and Brumfield Sales Co.

ORGANIZATION

18 Silver Anniversary booklet pictures and introduces personnel and departments of electric manufacturing company. Eagle Electric Mfg. Co.

SIMPLEX-PLASTEX

19 Ten-color data sheet 114 illustrates PLASTEX and discusses physical and electrical properties under varying conditions of temperature. Simplex Wire and Cable Co.

CODE CHANGES

20 Booklet discusses all changes in 1946 Code and illustrates what they mean to the electrical industry in terms of profits. Anaconda Wire and Cable Co.

THEATRE LIGHTING

21 Modernizing the Theatre with Light is 24-page booklet filled with practical ideas for utilizing fluorescent lamps for both illumination and special theatrical effects. General Electric Co.

DIMMERS

22 Bulletin 74 presents reactance dimmers for modern stage switchboards, explaining the selection factors, operation and maintenance, applications, specifications and types of equipment. Ward Leonard Electric Co.

CAPACITROL

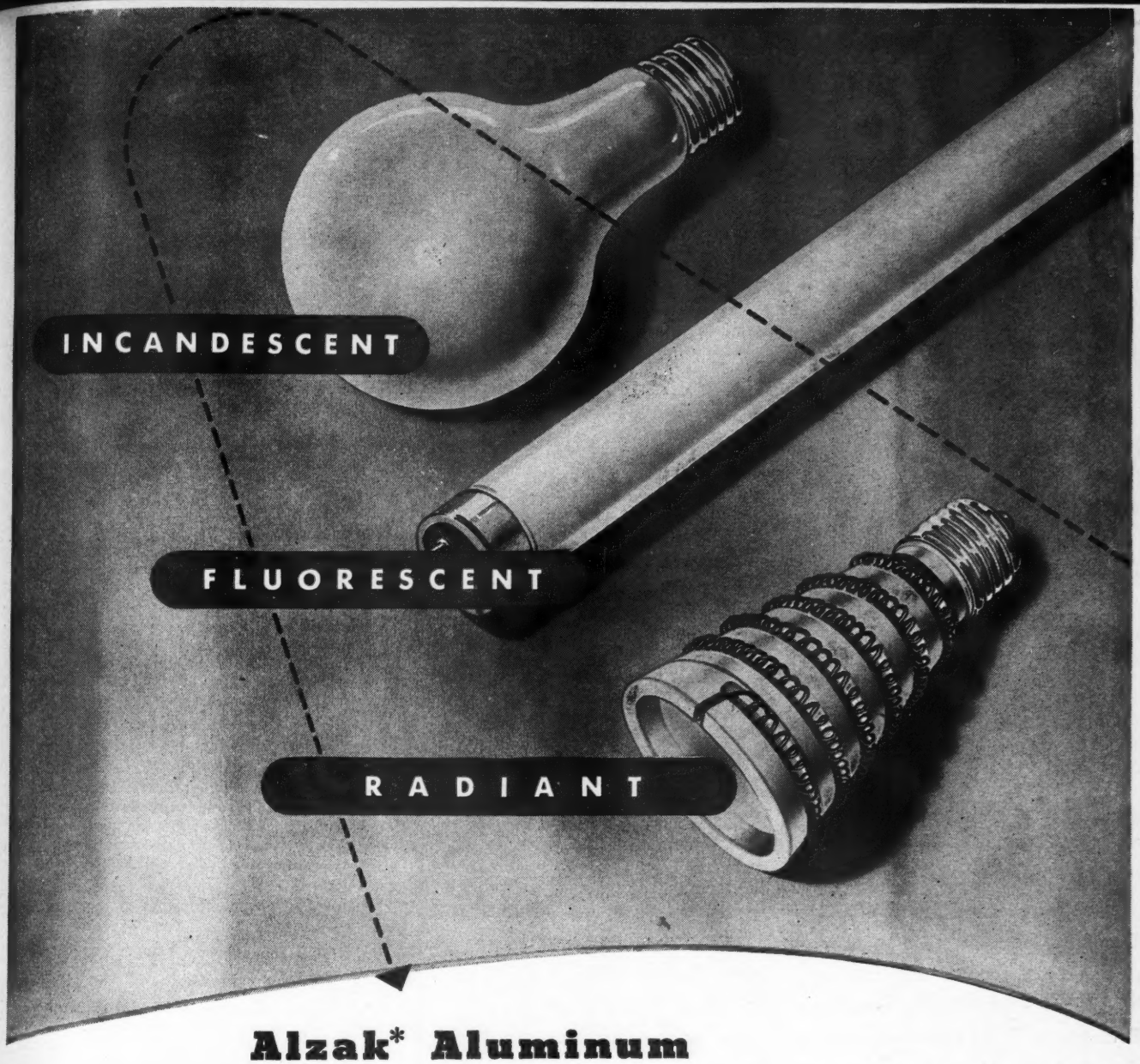
23 Bulletin D4-2 describes series of electronic temperature controls and the multronic capacitrol. Applications and features are presented in three-color installation diagrams and concise text. Wheelco Instruments Co.

PRESSURE CONNECTORS

24 Bulletin 64 pictures, discusses and suggests methods of applying and using solderless pressure connectors in the Lock-Tite Line. Test results in heat runs, secureness and pullout tests are included. Thomas and Betts Co.

LIGHT FOR SCHOOLS AND OFFICES

25 Two 8½ by 11-inch, 12-page, full-color brochures are devoted to lighting of schoolrooms and offices, incorporating the creative ideas of leading architects in these fields. The titles are "Remodeling with Light to Streamline Office Space" and "Arches of Light for Modern Schoolrooms". General Electric Co.



Alzak* Aluminum makes the ideal reflector for all 3!

The high efficiency of Alzak processed aluminum reflector sheet on incandescent, fluorescent, or radiant heating applications makes it the favorite reflector material for every job. Its easy formability gives you free rein in design, with the assurance that any shape may be readily drawn, spun, or formed. And you can count on the durability that characterizes corrosion resistant Alcoa Aluminum, plus the extra protection afforded by the Alzak reflector process. Suggest the advantages of Alcoa Aluminum, and the additional advantages of Alzak finishes to your manufacturer. Consult our nearest sales office, or write:

ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Pennsylvania.

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ALCOA

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IN EVERY COMMERCIAL FORM

GREENLEE HYDRAULIC BENDER

"Among the many reasons why we are so well pleased with our GREENLEE Bender is the fact that it is made in one unit and requires only one operator." Thus states Mr. E. A. Koeneman, President of E. A. Koeneman Electric Co., St. Louis, Missouri.

"And," he continues, "it saves valuable man hours and reduces need for manufactured bends and fittings by 25% to 50%. It's easily set up and is so small that it can be carried in the back of a sedan."

You, too, can make valuable time and materials savings with the GREENLEE. With it one man can in but a few minutes make accurate, smooth bends in rigid and *thin-wall* conduit, pipe up to 4½", tubing, bus-bars.

Get complete facts today on this equipment that quickly pays for itself, does the job faster, smoother, better! Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1748 Columbia Avenue, Rockford, Ill.

80th Anniversary 1900 1946 GREENLEE MACHINERY AND TOOLS

Sales Agents for Canada: Richardson & Bureau, Ltd., 129 St. Peter Street, Montreal.

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

LIGHTING EQUIPMENT

26 Catalog 46 presents engineered details of lighting equipment designed for offices, drafting rooms, stores and schools. Construction details with full dimensional data, light distribution curves, and tables for estimating lighting results, are included in the 40-page booklet. F. W. Wakefield Brass Co.

ELECTRIC COUNTER

27 Application data on MA electric counters for circuit breakers, switches, elevators, pumps, scales and production machines is outlined in new folder. Royal Electric Mfg. Co.

SOLDERING IRON

28 Single-sheet discussion of Balanced Heat P-150 soldering iron. Hexacon Electric Co.

MAGNALITE

29 Three-color folder describing new visual aid of unusual design, recommended to doctors, dentists, first aid rooms and hospitals for combining magnification and illumination for examinations. Operation and design are plainly pictured and explained. Haas Corp.

FLUORESCENT LAMPS

30 Basic principles and operating characteristics of fluorescent lamps and auxiliaries are explained in booklet A-4759. Structure and operation of mercury vapor electric discharge tube with phosphor coating is shown diagrammatically and complete ratings are listed. Westinghouse Electric Corp.

CODE CHANGES

31 Chart ((22 by 19 inches) showing changes in branch circuit wiring requirements in the 1946 National Electrical Code shows difference betwen present and 1940 codes. United States Rubber Co.

SYNCHRONOUS MOTOR CONTROL

32 Selection and Application of Synchronous Motors and Synchronous Motor Control is a two color, 24-page booklet, containing over 50 illustrations, diagrams and tables. Operating characteristics, power factor, torques, flywheel effect, speeds, excitation, starting kva., braking, motor protection, types of control and considerations of cost are in the treatise. Electric Machinery Mfg. Co.

JACKS

33 Eight-page folder describing and illustrating all the various models and types of rachet, screw and hydraulic jacks. Bulletin 1040D. Buda Co.

ANHYDROPRENE WIRES

34 Data sheet illustrating and describing Anhydroprene Wires and Cables gives information about neoprene jacketed, Anhydrex insulated wire and cable. Simplex Wire and Cable Co.

SANGAMO

Astronomic Dials

AUTOMATIC IN OPERATION

Give you big sales advantage . . .

Here is value PLUS . . . value to you in selling "on" and "off" control for practically all lighting installations . . . value to your customers in obtaining unusual precision and accuracy of operation.

SANGAMO TIME SWITCHES fitted with Astronomic Dials do not have to be changed manually. The Astronomic "on" and "off" arms automatically follow the sun's schedule for timing — the setting changes daily in accord with the sun as its rising and setting time gradually changes.

Any of the Astronomic Dials permit of the "off" operation at any time between 9:30 P. M. and 2:15 A. M. Special schedules of operation to suit the needs of exceptional cases may be obtained.

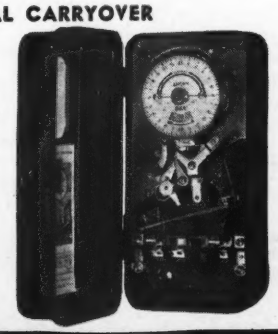
Both of the Sangamo Time Switches shown here are equipped with Astronomic Dials.

FORM KAZ
SYNCHRONOUS MOTOR
WITH ASTRONOMIC DIAL

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff.

FORM VSWZ WITH
ASTRONOMIC DIAL CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of resetting the dial after current interruptions, and insures accurate timing under all conditions.



SEND FOR

Catalog 1000

This very complete SANGAMO TIME SWITCH catalog gives full details. It will be well worth your while to send for it now as an aid to sales. Included in the eleven forms of SANGAMO TIME SWITCHES supplied with ASTRONOMIC DIALS are outdoor as well as indoor forms.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Available Now! These Repair Parts Fit MILLIONS of MOTORS

Every Repairman needs this Handy "On-the-Job" Assortment of Wagner Motor Repair Parts

Be a "One Tripper"—carry this kit in your car for "on-the-job" motor repairs.

It contains fast-moving parts for repulsion-start induction brush-lifting and capacitor-start induction-run motors—up to and including ½ hp.

Order for each of your men. Use coupon below. Also available at 325 authorized service stations.

Wagner Electric Corporation
6413 Plymouth Avenue
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Date_____

Gentlemen:

Please ship_____(Quantity) Motor Parts Assortment M-1 at $8.57 each (Net) total $_____.

☐ Also send copy of Motor Parts Catalog MU-40

Company_____

Address_____

City_____ Zone_____ State_____

M46-19

Wagner WE Electric

GERMICIDAL LAMPS

35 Two color, four page folder presenting specific examples to prove claims of reduced disease of hens, promotion of faster growth and increase in eggs produced through use of germicidal lamps in poultry houses. General Electric Co.

PIPE TOOLS

36 Folder presenting description and price of complete pipe tool line, all individually pictured and discussed. Beaver Pipe Tools Inc.

RELAYS

37 Four page catalog of a-c and d-c relays and control devices for welding, heating, telephones, radio, display signs, business machines and signal systems. Automatic Electric Manufacturing Co.

BUS DUCT

38 Forty-page letter-size data book to provide ready aid in the selection and application of a bus duct system. Three typical installations are analyzed with step-by-step diagrams, photographs and discussions. Standard ratings of breakers, temperature conversion tables, formulas for determining amperes, horsepower. Booklet B-3714. Westinghouse Electric Corp.

WELDING CONNECTIONS

39 The 1946 Twecolog includes every tool and fitting required on a cable, both electrode and ground, to mechanically hold and electrically transmit welding energy from the welding machine to the point of deposition. Tweco Products Co.

HOME WIRING

40 Four degrees of home electrification are outlined for consumers, architects, builders and contractors in 12-page illustrated booklet. B-3774. Westinghouse Electric Corp.

ELECTRICAL INSTRUMENTS

41 Eighteen page release includes photographs, technical data, price, performance and application for switchboard and portable ammeters, voltmeters and wattmeters. Norton Electrical Instrument Co.

HAMMER

42 Bulletin BE-12 describes split-jaw construction of soft-faced Basa hammer designed to speed construction, repair and metalworking operations involving surfaces that must not be marred. Greene, Tweed and Co.

BELTING

43 Catalog designed to aid industrial plants and maintenance men in the selection of the proper belting for any specific job presents information concerning line of conveyor, transmission and elevator belting in two-color loose leaf form. Hewitt-Robins Inc.

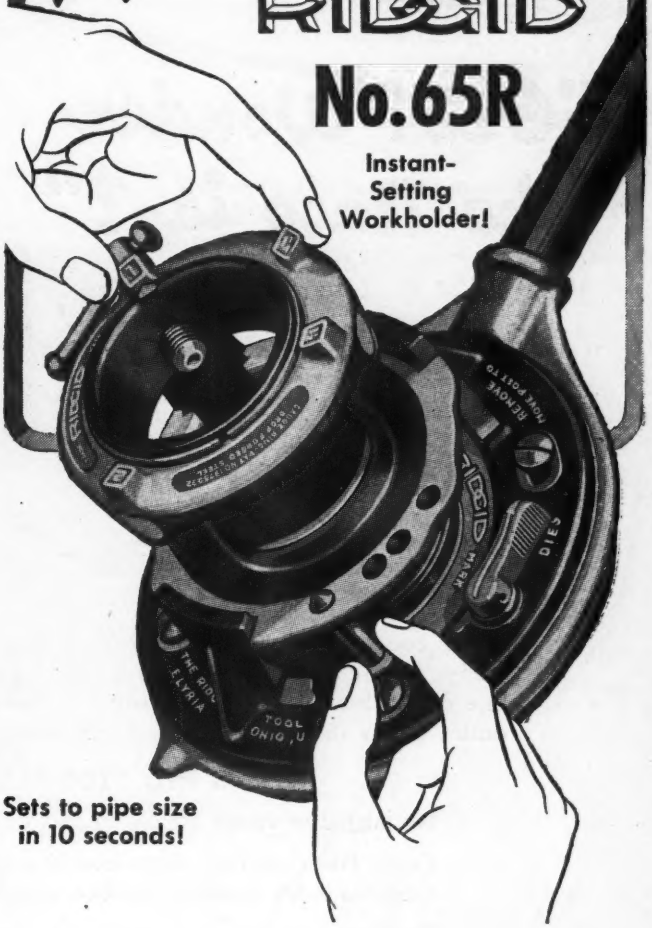
Takes a lot of your work out of cutting pipe...this *fast-action 4-wheel* RIDGID pipe cutter

Regular Heavy-Duty RIDGID *Cutters in 5 sizes.*

Good reasons why this 4-wheel RIDGID pipe cutter is such a favorite everywhere. It cuts pipe fast and clean with least effort. Designed with short handle to work in tight quarters, it cuts quickly even where you have room only for a quarter turn Special malleable body assures alignment, it always cuts true — every cutter factory tested. You'll like this efficient worksaver RIDGID — ask for No. 42 (1/2" to 2") or No. 44 (2 1/2" to 4") at your Supply House.

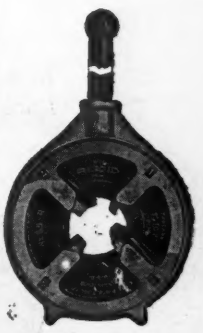
Gives you a new idea of quick easy *pipe threading* RIDGID No. 65R

Instant-Setting Workholder!



Sets to pipe size in 10 seconds!

This popular No. 65R cuts perfect threads on 4 sizes of pipe, 1" to 2," with 1 set of high-speed steel chasers — no changing, no loose dies to carry or lose. And it sets to pipe size in a mere 10 seconds! A turn of the cam plate sets the workholder to size instantly . . . one screw to tighten on pipe, no bushings to bother with. Many other worksaver features you like in this rugged precision-made tool. See No. 65R at your Supply House.



RIDGID *No. 65R stands up handily on its own feet.*

Millions of RIDGID Tools in use

★ RIDGID ★

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.

● Of course you wouldn't know, sonny, But it's a well-known name in certain circles . . . architects, builders and contractors know that Raco signifies a trade-marked line of All-Steel-Equip Company . . . the complete line of steel switch boxes and outlet boxes that are preferred the nation over.

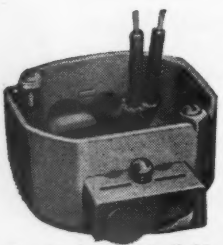
HERE'S WHY "YOU CAN ALWAYS RELY ON RACO"

No jagged or rough edges, no dirt or grease. Smooth, attractive appearance!

Every Raco product comes neatly packed in a good-looking carton . . . with a readable index showing number, quantity and finish.

The same exacting standards are used as in other precision products that All-Steel has been manufacturing for more than 33 years.

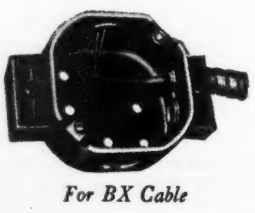
In addition to this, the Raco • All-Steel line is sold nationally through wholesalers only. Look for the Raco trade-mark . . . it signifies the quality line, the line that you can depend on.



For Non-Metallic Cable

THE JAY-KAY (J-K) BOX

Made for "BX" but with bushing plate removed, it becomes a box for non-metallic cable. Supplied in 3¼" and 4" diameters. Boxes only, or assembled on bars; external clamps allow more wiring room. Use this box now when connectors are scarce.



For BX Cable

ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES

In the News

AIEE Studies Industrial Problems

Technical sessions covering electrical safety, industrial power applications and industrial electrical control devices attracted a substantial number of the 1300 registrants at the recent summer convention of the American Institute of Electrical Engineers in Detroit. Practically every phase of the generation, distribution, application and control of electrical energy was considered in various meetings during the five-day conference.

The subject of low voltage shock hazards received detailed study at the session on electrical safety. Charles F. Dalziel, University of California, outlined the results obtained by numerous experiments on animals and men and women in his laboratory. He reported that sinusoidal currents in excess of 100 milliamperes at 60 cycles—from hand to foot—would be dangerous for shock durations of three seconds or more. "Let-go" currents for human beings tested showed that 99.5 percent of 28 women could let go of the conductor at 6 milliamperes, 50 percent at about 10.5 ma.; 99.5 percent of 134 men could let go at 9 ma.; 50 percent at about 16 milliamperes. Greatest danger of low voltage shock is death caused by ventricular fibrillation—a spasmodic condition of the heart muscles or lack of smooth functioning of the heart action.

M. M. Brandon, Underwriters Laboratories, Inc., reiterated the Dalziel findings, adding that the greatest resistance to current paths through the body is through the skin. With wet hands and feet, extremely low voltage may cause unsafe currents to pass through the body, he warned. Since a majority of low voltage shocks occur by touching grounded portable electric equipment, Mr. Brandon urged engineers to campaign against its use in damp or wet locations. Expressing a hope that the Electrical Committee, NFPA, will find an adequate solution to the portable electric equipment shock problem, he suggested an educational program to prevent improper use of electrical equipment as one method of reducing the number of fatalities resulting from low voltage shock.

Silent, invisible hazards in our industrial plants today are provided by X-rays and gamma-rays used extensively for the non-destructive inspection of products, warned S. Reid Warren, Jr., University of Pennsylvania. Mr. Warren discussed the "delayed-action" effect of such rays as ultimate destroyers of living tissue—reaction to exposure may not appear for several years. In view of this phenomenon, he urged protection against such rays by: (1) choice by physicians and biological scientists of a tolerance dose—the human body may absorb small amounts of radiation without harm; (2) economical choice of protective methods to prevent exposure to more than a tolerance dose; and (3) means of testing protective methods to guarantee their effectiveness. Lead barriers and thick concrete walls offer economical protection, it was stated.

Progress on the development of recommendations on acceptable spreads in the utilization voltage of industrial apparatus was reported by John Grotzinger, chairman, AIEE subcommittee on Industrial Voltage Requirements. The recommendations, when published, will apply only to industrial plants served at primary voltage and where most of the electrical apparatus are connected to the secondaries of one or more distribution transformers.

Based on a 130-plant survey (500 questionnaires sent out) and committee work to date, the following tables show the recommended voltage spread:

Permissible Voltage Spread in 600 Volt (and less) Industrial Distribution Systems

(as determined by Utilization Device Characteristics)

Nominal System Voltage	Utilization Device Ratings	Voltage Limits at Device Terminals: Recommended	Voltage Limits at Device Terminals: Permissible
208Y/120	115 or 120—1 ph.	205Y/118	199Y/115
	208 or 220—3 ph.	216Y/125	216Y/125
230	220	211–237	209–242
460	440	422–475	418–485
575	550	528–594	523–605

Permissible Utilization Voltage Spread of Motors Served At Primary Voltage

Primary System Voltage	Name Plate Motor Rating	Maximum Utilization Voltage Range: Lower Limit	Maximum Utilization Voltage Range: Upper Limit
2400	2300	2185	2520
4160	4000	3800	4360
6900	6600	6270	7200
11500	11000	10450	12000
13800	13200	12540	14400

The above tables are based on a utilization voltage that is not more than four

"Maw sure is happy since we got the place wired for electricity. Look at her dance."

Yes, you can now think about new signs . . . better signs . . . *properly illuminated.* It's time to act, too, to assure delivery of lighting equipment when you need it.

KEYSTONE
Emblem Sign Reflectors

Designed specifically for illuminating square or rectangular signs, the Goodrich Keystone Reflector provides maximum and uniform illumination. Its Keystone shape, with straight line sides provides light cut-off at exact edges of the sign, without waste of light. The light pattern is "tailored" to fit.

Permanent porcelain enamel finish makes it timeproof, weatherproof. The Goodrich Separable hood makes it quick and easy to attach and detach without use of screws. Lamp burns in normal vertical position; resilient socket lengthens lamp life. Other Goodrich sign reflectors similarly illuminate round, oval, or long and narrow signs. The complete Goodrich line includes hundreds of sizes and styles of reflectors for every outdoor and industrial need. Write for literature.

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percent under rated motor voltage, nor more than six percent above. Allocation of voltage drop was made on the following basis: 85 percent power factor; 3 percent secondary wiring drop at normal load; 3.2 percent regulation of distribution transformer; and 5 percent line regulation from utility's primary substation to primary side of user's distribution transformer.

The above utilization voltage was deemed by the committee as the best to meet requirements of the general purpose motors making up largest part of industrial loads. The committee voiced opposition to any further increase in primary distribution voltages since, to do so would obsolete transformer equipment purchased within the past five years.

L. C. Peterman, electrical engineer, Ford, Bacon & Davis, Inc., New York, discussed the application of protective devices in industrial plants by describing installations designed by his firm during the war. Thermal circuit breakers when used as disconnects and short circuit protection for individual motors—on circuits backed up by magnetic trip breakers—will not trip under certain conditions of short circuit on their load side, he warned. Rather, the magnetic breaker will trip, de-energizing the entire circuit. Mr. Peterman suggested caution in designing such a circuit and recommended fuses for motor protection since they can be better coordinated with the magnetic service breaker. Universal application of packaged switchgear and protective equipment to all plants is neither practicable nor economical, stated Mr. Peterman, who advocated simple, balanced designs in which bulk supply feeders, transformers, switching and subfeeders are closely adjusted to actual load with limited emergency capacity provided at a nominal cost.

Recognition of short circuit currents in low voltage systems is a new concept of electrical distribution in commercial buildings, asserted D. L. Beeman, G. E. Co., who reviewed the economics of several types of distribution systems. Audience discussion of this paper revealed: (1) For office buildings up to 15 floor height, 208/120-volt, 3-phase, 4-wire distribution with basement service is most economical; (2) air-conditioning loads of 2½ tons of refrigeration (5½ hp. including pumps, fans and compressors) is necessary for each 1,000 sq. ft. of office space; (3) 40 to 50 footcandles of illumination requires about 3½ watts per sq. ft.; (4) air-conditioning loads for motors up to 100 hp. can be taken from the conventional building service, 100 to 250 hp. direct from primary of network service, above 250 hp. separate radial primary feeders from the utility station may be necessary.

Reviewing factors involved in insulation breakdown due to surge voltages, H. R. Vaughn, Westinghouse Electric Corp., outlined various methods of neutral grounding that can be applied to minimize this hazard.

Advancements in the field of electrical control were presented at the industrial control sessions: W. D. Cockrell, General Electric Co., described an electronic register control for multicolor printing—a system containing equipment extending all the way from phototubes to the thyratrons which supply the required current to energize the correcting motor armature in the proper directions and at the speed for correct register. With this system, Mr. Cockrell stated, fewer than one copy in 25 was found not perfectly registered. High accuracy and long life are features of this method, he concluded.

An extended lease on the thermal life of magnet coils is given by silicone resin insulation, according to G. L. Moses of the Westinghouse Corp., and J. J. Torok of the Corning Glass Works. Tests and other evidence indicate that magnet coils with fibre glass insulations can be rated at a temperature appreciably above the 160° C temperature by resistance proposed for silicone insulation on rotating machinery, they concluded. This presents a distinct design advantage.

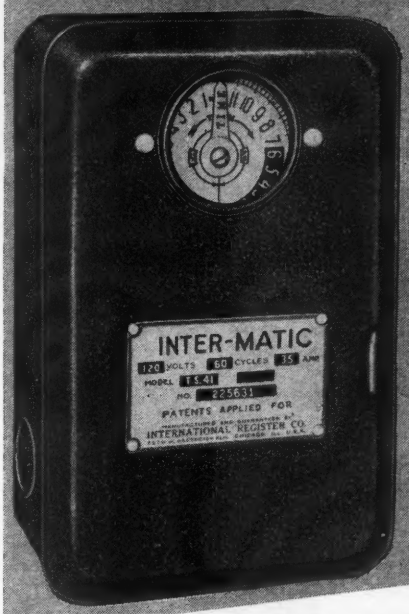
A recently developed electronic drive for windup reels (for reeling continuous strips of yarn, fabric, wire or steel) was described by K. P. Puchlowski, Westinghouse Electric Corporation. The system was developed for reels that also perform the drawing of the strip.

R. Koller, University of California, explained the theory and experimental investigations that may lead to the development of a vacuum switch capable of interrupting medium a-c or d-c loads.

New cable developments discussed at the meeting included the description by L. F. Hickernell and C. J. Snyder, Anaconda Wire and Cable Company, of the F-3 Lead Alloy (arsenical lead with small amounts of tin and bismuth)—an improved cable sheathing. The authors claim that this sheath—already used on cable in commercial installations—has better power cable sheath properties than any material yet tried; that larger cables can carry heavier loads without shortened life due to sheath cracking in manholes; that single sheaths can be used on some pressure-type cables where a double lead sheath would be necessary; that a reduction of troubles in service will be effected because sheath is harder than commercially pure lead.

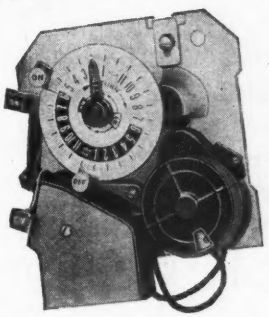
Myron Zuker, Mackworth G. Rees, Inc., discussed the physical and electrical characteristics of a low-reactance flexible cable (an interleaved type) for use on induction heating circuits and equipment.

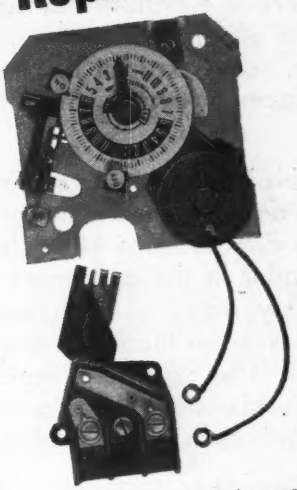
The INTER-MATIC TIME SWITCH is Well Engineered



DESIGN FEATURE No. 4

Rugged, Easily Replaced Terminal Block





The terminal block is molded from Bakelite. Ample provision is made for heavy wire connections. Over-size terminal screws permit firm pressure to insure good electrical contact.

The terminal block is removed by turning out two screws. The block also carries the contact blades which can be easily adjusted or replaced.

Write for Catalog and name of nearest Distributor.

$9.00 LIST
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115 V., 60 Cycle

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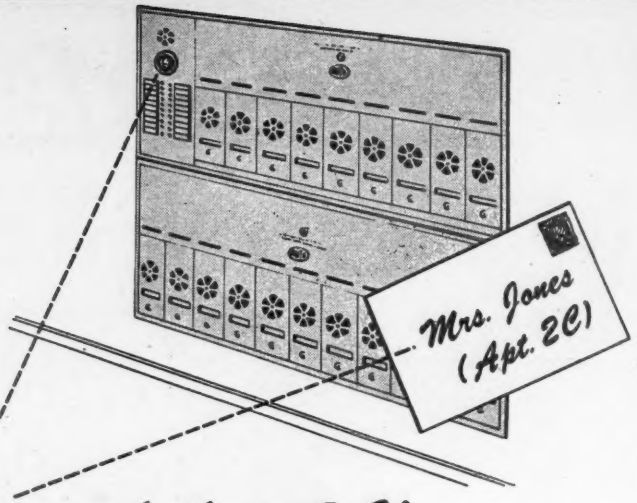


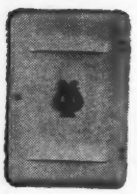
Mrs. Jones (Apt. 2C)

RELIES ON AUTH 3000 TIMES A YEAR!

Mail several times daily from the Auth apartment mail box — several visitors putting the Auth chimes and door-opener to work, sometimes using the lobby phone—Auth bells morning and evening for the service elevator—occasionally a call to the superintendent or doorman. Yes, Mrs. Jones and all her neighbors make amazingly hard use of Auth equipment.

For just this kind of severe service, Auth has been designing and making superior signaling devices since 1892, and now is the leader in the apartment systems field. Every detail of Auth equipment means service for modern living, longer electrical life, greater mechanical strength, and easier installation with lasting beauty in both tone and appearance.

All types of apartment telephone systems

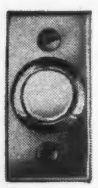


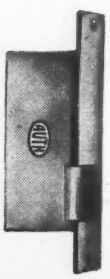
Auth Flushchimes, with amazing tonal beauty. Also manually operated door chimes

Complete line of bells and buzzers, including compact, flush-mounting types

YOU, TOO, CAN RELY ON AUTH—

As a result of Auth's rigid factory inspection and Auth's guarantee, you'll have no trouble with complaints due to equipment failure. And you can rely on the Auth catalog, for in it you'll find every signaling device you need for apartments and housing projects.





Push buttons and door releases

ASK FOR AUTH APARTMENT BULLETIN 95

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SINCE 1892

CPA Broadens Priority System

On July 11 the Civilian Production Administration broadened its priority system to speed the production of certain electrical wiring devices—such as sockets, outlets, and switches—important to the housing program.

The following wiring devices, the manufacturers of which may be assigned ratings for production materials, certain capital equipment and materials and equipment required for maintenance, repair and operation, have been added:

(1) Sockets, lampholders, and lamp receptacles—medium screw base types—lighting fixtures and portable lamps not included. (A lampholder consists of a socket and a housing (generally one-piece) which attaches directly to a ceiling or wall outlet, without intervening suspending or protruding devices. It may be designed so that shades and other similar appurtenances may be attached, but, in that event, the appurtenances are not part of the lampholder itself.)

(2) Convenience receptacles (outlets)—types suitable for residential use.

(3) Toggle switches—types designed specifically for tools and appliances not included.

(4) Wall and face plates.

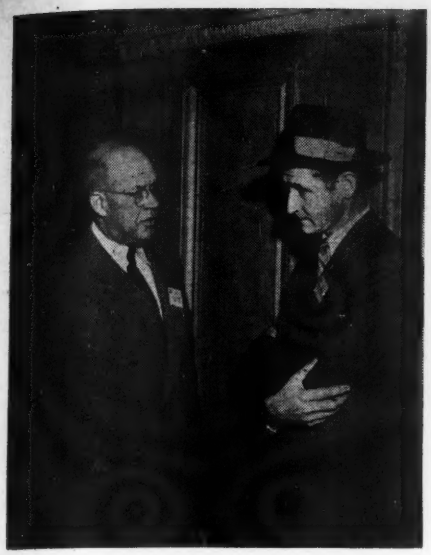
(5) Outlet, switch, and receptacle boxes—types suitable for residential use—covers, hangers, supports, and clamps included.

(6) Box connectors for residential-type metallic—or non-metallic—sheathed cable.

Production of these devices, many of which are also needed by the Rural Electrification Administration to help farmers to produce more food, is now running from 40 to 50 percent below expected requirements, CPA said.

By amending Schedule 1 to Priorities Regulation 28, under which CC ratings are granted to break industrial bottlenecks, CPA will now grant rating assistance to manufacturers of selected electrical wiring devices. Schedule 1 lists the items which have been declared by CPA to be in critically short supply, the manufacturers of which are entitled to apply for rating assistance.

At the same time CPA made public its estimates of the over-all requirements of the devices for the year 1946. These are: toggle switches, 51,000,000; convenience receptacles (base plugs) 52,000,000; medium base sockets, 120,000,000; wall plates, 61,000,000; switch, outlet, and receptacle boxes, 130,000,000; and box connectors for metallic and non-metallic sheathed cable, 194,000,000.



Prominent in Oklahoma's electrical contracting fraternity are (L to R) L. T. Allen (NECA v.p., Div. 5) Allen Electric Company, Tulsa; and Marvin R. Osborne, Osborne Electric Co., Oklahoma City.

Brandon Appointed Electrical Engineer

The Executive Committee, Board of Trustees, of Underwriters' Laboratories, has promoted Merwin M. Brandon to the position of Electrical Engineer. Effective immediately, Mr. Brandon assumes full responsibility and direction of the activities of the Electrical Department of the Laboratories at the Chicago, New York, and San Francisco testing stations.

Brandon will also serve as Chairman of the Electrical Council of the Laboratories.

Having served for many years with the late Robert B. Shepard, Mr. Brandon takes over, intimately acquainted with the policies and the problems of his position and can be counted upon to promote the service of the Laboratories in its contacts with most of the phases of the electrical industry.

Mr. Brandon will continue his headquarters at 161 Sixth Avenue, New York City.

Young Re-elected NCEI Chairman

H. E. Young was re-elected chairman of the North Central Electrical Industries, Minneapolis, Minn., for the current year. Other officers include: R. F. Pulver, first vice-chairman; Wm. G. Stuefer, second vice-chairman; L. G. Mample, treasurer; and Wm. A. Ritt, secretary-manager.

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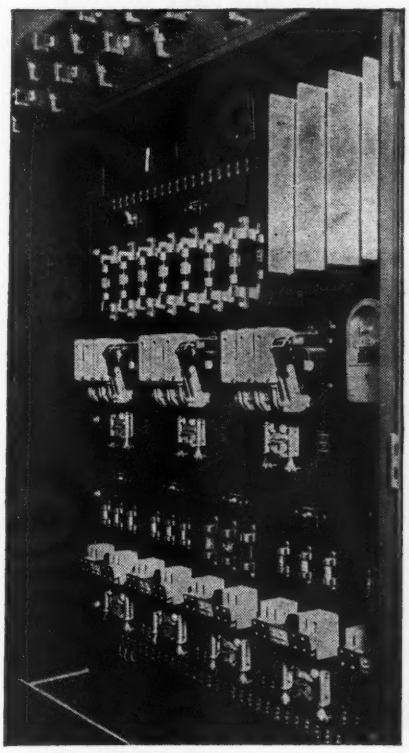
Specialists in CUSTOM-BUILT MOTOR CONTROLS

For over 50 years we've been specializing in the design and construction of *unusual* electric motor controls. This means building *your* specifications and *your* requirements into specialized controls of all types, for all purposes—including printing presses, machine tools, synchronous motors, pumps, laundries, ventilating fans, dairies and many more.



A wide range of industries are served by Monitor. Above you see a partial view of a Monitor installation in a leading Kentucky theatre where the problem was heating and air conditioning.

So if your motor control problem is "out-of-the-ordinary," be sure to consult your nearby Monitor Field Engineer. His specialized knowledge will save you time, money and headaches in working out unusual control arrangements on present products and new product developments. Representatives in all principal cities.

If it's custom-built...
MONITOR
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NOW YOU CAN GET Blo-Fan CEILING VENTILATORS FROM YOUR LOCAL SUPPLIER

The General Electric Supply Corporation and selected independent wholesalers across the country once more are ready to supply Blo-Fan Ceiling Electric Ventilators.

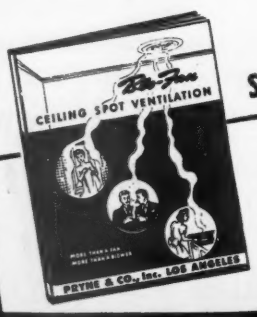
Well known before the war as the most efficient small ventilator built, Blo-Fan soon will be ridding thousands of additional homes of unwanted air. Cooking vapors and odors—bathroom fog—gameroom smoke and liquor fumes—laundry steam, all are eliminated *as they rise* by

Blo-Fan

CEILING VENTILATORS

Installed *directly over the source* of foul air—Blo-Fan gives nature a boost by catching vapors before they spread or soil interior decorations and furnishings.

Get your share of this profitable ceiling ventilating business. Ask your local wholesaler about the 1946 models of Blo-Fan Ceiling Ventilators.



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DISTRIBUTED BY G. E. SUPPLY CORPORATION AND SELECTED INDEPENDENT WHOLESALERS ACROSS THE COUNTRY

Board of Directors were: Glenn F. Rowell, representing the Minnesota Electrical Inspectors Association; Frank Langford, electrical contractors; Ralph F. Geeseka and M. C. Balch, electrical manufacturers. Together with the officers and D. E. Ford and C. J. Christopher, they comprise the present Board of eleven members.

Rochester Chapter Elects Officers

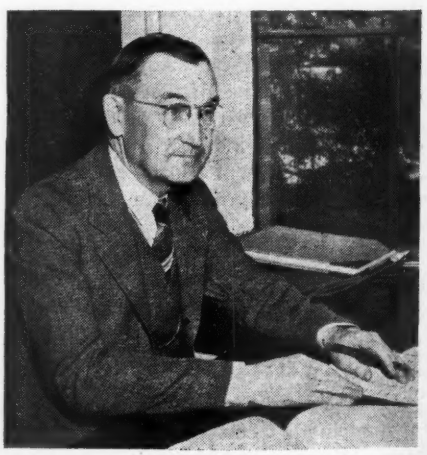
At a recent meeting of the Rochester Chapter, NECA, Inc., the following officers were elected for the year 1946—R. E. Hornbeck, president; Al Mueller, vice-president; Earl Driscoll, treasurer and E. A. Vanderlinde, governor (NECA).

Minnesota Plans Business Promotion

The Directors of the North Central Electrical Industries, Minneapolis, Minn., recently approved plans to organize five All-Industry Committees to program business development promotions in the following fields.

1. Domestic Electric Appliances.
2. Residential, Commercial and Industrial Lighting.
3. Commercial and Industrial Electric Equipment.
4. Rural Electric Equipment.
5. Adequate Wiring.

Electrical wholesalers, manufacturers, contractors, utilities, dealers and inspectors will be asked to name representatives to serve on each of the five



Oscar L. Harris, office manager, D. L. Zimmerman Electrical Machinery Company, Wichita, Kansas, believes accurate cost records to be the backbone of any successful business. The large number of motor and transformer repair orders on file attest to that.

Checking motor repair price lists are (L to R) C. C. Smith and J. A. Milligan, operators of Smith-Milligan Electric Company, Tulsa, Oklahoma, one of the largest motor service organizations in the Tulsa area.

committees to outline the scope and direction of each promotion activity. They are to keep their own respective groups fully informed on the over-all planning. The Board agreed that this committee arrangement will insure even greater cooperation of the various industry branches in the area than has been accorded in the past on business development activities of the organization.

By approval of the Board, the North Central Electrical Industries will again function as the agency for certification of Adequate Wiring Installations. Immediately NCEI secures NAWB approval as a certifying agency, the Minnesota Certified Wiring Plan—suspended during the war—will be re-established.

Under present plans, NCEI will handle applications from any part of Minnesota, North Dakota, western Wisconsin, northern Iowa, and the eastern tier of counties in South Dakota.

Although many present residential wiring installations cannot meet certification requirements because of existing material shortages, plans for thousands of new homes have not yet reached the blueprint stage. It is expected that the announcement, to the trade, architects and builders, that NCEI will again process applications, check plans and issue Certificates of Adequacy, will give impetus to the entire residential wiring program throughout the area.

OPA Records To Be Kept For One Year

Manufacturers, wholesalers and retailers, and all other persons required under price control regulations to have kept records must preserve them until July 1, 1947.

Brown Electric Company

308 Canal St., New York 13, N. Y.
1008 Race St., Philadelphia 7, Pa.
700 Murphy Ave., S. W., Atlanta, Ga.

Distributors of:

Motor Repair Parts	**Electrical Insulation**
Carbon Brushes	**Magnet Wire**
Capacitors	**Coil Winding Equipment**
Commutators	**Motor Testing Equipment**
Bearings	**Controls**

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Send a copy of your Catalog No. 6 to:

NAME .....TITLE.....

COMPANY .....

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3 LABELS TO LOOK FOR
ON
FLUORESCENT LAMP BALLASTS

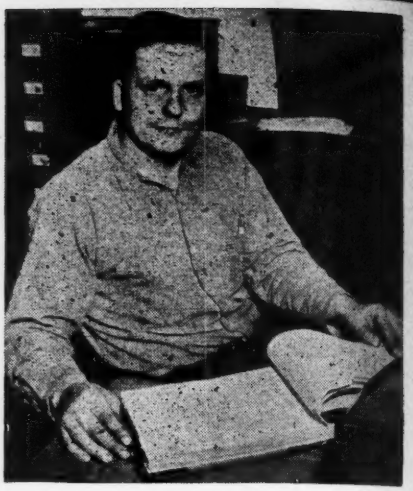
When a label is familiar to a buyer, it is usually because the organization so identified is long-established in its particular field.

Chicago Transformer ballasts can boast of three such labels—the C.T.C. emblem, a trademark of manufacturing experience, plus the U.L. and E.T.L. insignias, trademarks of two recognized testing laboratories.

C. T. C.—*Manufactured by Chicago Transformer.*
U. L. —*Approved by Underwriters Laboratories.*
E. T. L.—*Certified by Electrical Testing Laboratories.*

. . . Three labels to look for on fluorescent lamp ballasts, because ballasts bearing them win confidence for the lighting equipment in which they are installed.

CHICAGO TRANSFORMER
DIVISION OF ESSEX WIRE CORPORATION
3501 ADDISON STREET · CHICAGO, 18



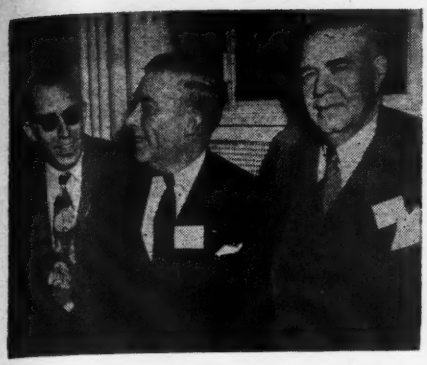
George A. Moore, as partner and shop supt. of Mears Electric Co, Wichita, Kansas, is in charge of motor repairs for one of the oldest motor service organizations in that area. Mears has been in this business for 39 years.

The action, Supplementary Order 167, effective as of June 30, 1946, was taken in order to enable OPA to carry on the powers and duties directed to it under the Executive Order 9745 signed by President Truman on June 30, 1946.

The Executive Order authorized OPA to continue all the functions, powers and duties vested in it by the Emergency Price Control Act of 1942, as amended, and the Stabilization Act of 1942, as amended, which did not terminate by expiration of those acts, June 30, 1946.

OPA pointed out that Section 1 (b) of the Emergency Price Control Act of 1942, as amended, provided that all regulations, orders, price schedules and requirements shall be treated as remaining in force for the purpose of sustaining any proper suit, action or prosecution with respect to offenses committed or rights or liabilities incurred on or before June 30, 1946.

Degrees galore line the office walls of the construction division of the Oklahoma Electric Supply Company, Oklahoma City. Among the graduate electrical engineers on the staff is Kenneth T. Gillespie, vice-president of the firm.



Rural line construction specialists from Kansas City, Mo., (L to R) C. W. Johnson, H. L. Cater and W. S. Mann are all members of the Cater Electrical Construction Company of that city.

DATES AHEAD

Pacific Coast Convention—AIEE—Seattle, Wash., August 26 to 31.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., August 13.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., September 10.

Illuminating Engineering Society—National Convention—Chateau Frontenac, Quebec, Canada, September 18–21.

Omaha Electric Show—Sponsored by the Nebraska and Western Iowa Chapter, NECA, Omaha, Nebr., September 23–28.

International Association of Electrical Inspectors—Northwestern Section, Hotel Boise, Boise City, Idaho, Sept. 23-25; Southwestern Section, Hotel Sacramento, Sacramento, Calif., Sept. 30–Oct. 2; Southern Section, Asheville, N. C., Oct.; 14–16; Western Section, Gibson Hotel, Cincinnati, Ohio, Oct. 21–23; Eastern Section, Mark Twain Hotel, Elmira, N. Y., Oct. 28–30.

National Electronics Conference — Edgewater Beach Hotel, Chicago, Ill., October 3–5.

National Safety Congress—Hotels Stevens, Congress & Palmer House, Chicago, Ill. Week of October 7.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., October 8.

International Municipal Signal Association, Inc.—Annual Meeting—Miami Colonial Hotel, Miami, Fla., October 14 to 17.

National Electrical Contractors Association—Annual Meeting, Ritz Carlton Hotel, Atlantic City, N. J., Oct. 14–18.

National Electrical Manufacturers Association — Annual Meeting — Marlboro-Blenheim and Claridge Hotels, Atlantic City, N. J., October 28 to November 2.

All Industry Refrigeration and Air Conditioning Exposition—Public Auditorium, Cleveland, Ohio, Oct. 29–Nov. 1.

Manufacturers News

J. H. WARD ASSIGNED NEW DUTIES WITH NOMA

Joseph H. Ward, executive vice president of Noma Electric Corporation, has been assigned new responsibilities as sales director and supervisory officer for all of Noma's manufacturing and sales divisions and subsidiaries with the exception of those engaged in the household durable goods field and in automotive lighting.

Mr. Ward has been placed in charge of six divisions and ten subsidiaries including the toy, decorative lighting, plastics and

A New Data Sheet, richly illustrated, has been issued giving new information about Simplex-PLASTEX insulated wire. It contains important information that will help you to select the right type of wire for your work. It contains engineering information which illustrates why no one plastic compound is satisfactory for all wire and cable uses and lends weight to our statement that to get best results, plastic insulation, like rubber compounds, must be designed for the job in hand.

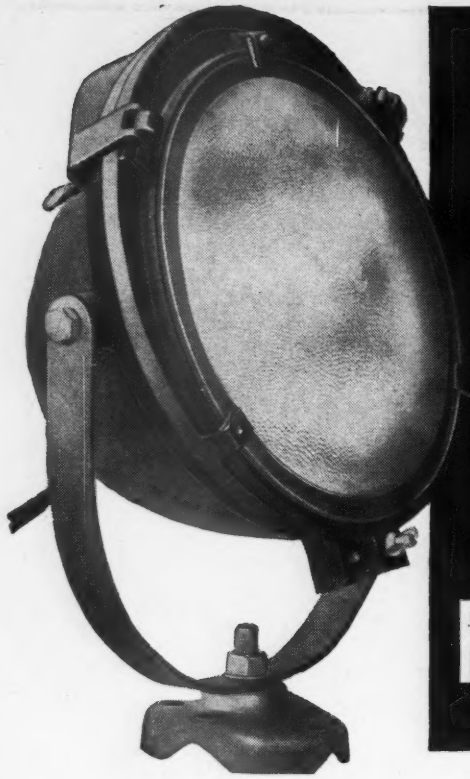
A copy of this Data Sheet will gladly be sent without obligation. Write for your copy of Data Sheet #114 today.

SIMPLEX

WIRES & CABLES

SIMPLEX WIRE & CABLE CO.

79 Sidney St., Cambridge 39, Mass.



Call G-E for FLOODLIGHTS

...and get these important advantages

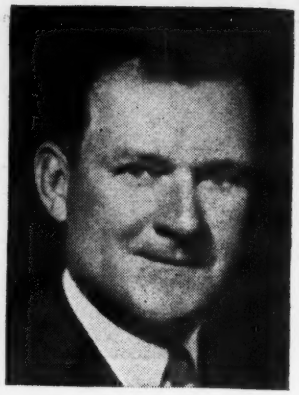
- ★ Proper types and sizes for all applications
- ★ High-efficiency, the result of scientific design
- ★ Long life and low maintenance expense, obtained through sturdy construction
- ★ Expert assistance with application problems, backed up by 30 years' experience
- ★ Convenient sales and service facilities

WANT THESE HANDY DESCRIPTIVE LEAFLETS FOR YOUR PROPOSALS?

FLOODLIGHT	PUBLICATION
Heavy-duty, steel casing	
200 or 250 watts, Type L-29	GEA-4303
300 or 500 watts, Type L-30	GEA-4304
750 or 1000 watts, Type L-31	GEA-4305
Heavy-duty, cast aluminum	
200 or 250 watts, Type L-38	GEA-4325
General purpose, sheet aluminum	
300 or 500 watts, Type L-49	GEA-4311
750 or 1000 watts, Type L-43	GEA-4310
Sports and area, sheet aluminum	
750 to 1500 watts, Type L-68	GEA-4333
Area, open porcelain enamel	
300 to 1500 watts (Type L-45)	GEA-4433
(Type L-46)	GEA-4432
Handy, sheet aluminum	
200 watts, Type L-66	GEA-4346
Underwater	
100/250/400 watts (Type L-33)	GEA-4438
500/1000/1500 watts (Type L-41)	GEA-4439

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC



J. H. WARD

capacitor divisions, The Ansonia Electrical Division, and Air Conditioners Sales Division.

Mr. Ward Joined Noma in 1927 as manager of the lamp division. He subsequently was employed in the sales department and as advertising manager, was made a vice president in 1938 and executive vice president in 1945.

WESTINGHOUSE CHANGES

The appointment of C. D. Kester as manager of the York, Pa. office of the Westinghouse Electric Corporation was announced recently. Mr. Kester succeeds E. M. Powell who has been appointed Machinery Electrification manager of the District.

C. C. Smith has been named special headquarters electronics sales representative assigned to the Westinghouse Southeastern District, with offices in Atlanta. His territory will include all of North and South Carolina, Georgia, Florida, Alabama and portions of Tennessee, Mississippi and Louisiana.

Westinghouse has started construction of a new plant, warehouse and office building on an eight-acre site in St. Louis. The two buildings will cover approximately 135,000 square feet of floor space, compared to 75,000 square feet at the present location and in outside warehouses.

D. M. Salsbury, executive vice president of the Westinghouse Electric Supply Company, has announced the purchase of the wholesale electrical supply branch of the Barnes and Brass Electric Company at Clarksburg, W. Va. Earl L. Charles, who had been employed by the Clarksburg firm for the past 16 years, was named manager. He will report to D. B. Williams, manager of WESCO's Central District, with headquarters in Pittsburgh.

G-E APPOINTMENTS

Harry K. Collins has been appointed manager of the Resin and Insulation Materials Division of the General Electric Company at Pittsfield, Mass. This position was formerly held by the late Edgar L. Feininger. Mr. Collins, who was manufacturing manager of the division in Schenectady, now assumes responsibility for over-all activities connected with G-E's new sili-

H. K. COLLINS

cone resins, oils, greases, rubber and water repellents as well as its Glyptal alkyd resins and insulating materials.

O. F. Hass, manager of the Continental Sales District of the G-E Lamp Department, with headquarters in Philadelphia, will succeed Charles K. West in charge of the Atlantic District. Mr. West is retiring after 47 years of service.

William H. Rademacher, manager of Mississippi Valley Sales District of the Lamp Department, has been named manager of the Lamp Department's Continental Sales District, Philadelphia, replacing Mr. West.

Bernard H. Sullivan has been appointed manager of the Mississippi Valley Sales District at St. Louis, succeeding Mr. Rademacher. Mr. Sullivan was formerly assistant to the manager of Midland Sales District, Chicago.

Announcement of Harry C. Calahan's election to the commercial vice presidency of the General Electric Supply Corporation has been made by the Corporation's board of directors. He succeeds Harry F. Thomas, who retired at the end of last year. Mr. Calahan's headquarters are in the G-E Building at 570 Lexington Avenue.

GRAYBAR PROMOTIONS

Graybar Electric Company has announced the appointment of N. E. Olsen as manager of the New Haven branch. Mr. Olsen goes to New Haven from Syracuse, where he has been manager since 1930.

J. E. Carroll will succeed Mr. Olsen as manager of the Syracuse branch. For the past eleven years he has been a salesman at Syracuse.

CONTINENTAL WIRE CORP. ORGANIZED

Announcement has been made of the formation of the Continental Wire Corporation, which will occupy the building at 501 Prospect Street, York, Pa.

The officers of the company, all previously connected with the York Wire and Cable Division of the General Electric Company, are C. C. Christiansen, president; Edgar Q. Harrigan, vice president; J. C. Shafer, secretary; and Harold Olden, treasurer.

Mr. Harrigan stated that at present the

RELIANCE AUTOMATIC TIME SWITCHES

Model "W"

Completely automatic . . . extremely simple, compact, economical . . . three types cover practically every requirement . . .

ASTRONOMIC TIME SWITCH

• The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of re-setting the dial as the days become longer or shorter.

AMERICA'S RELIABLE 24 hour-a-day GUARDIANS

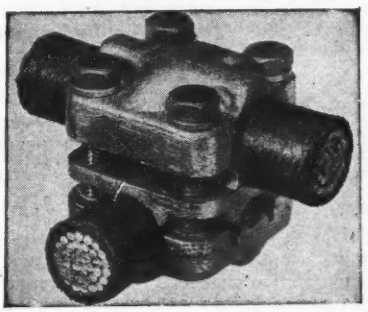
RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

RELIANCE AUTOMATIC LIGHTING CO.

1907 MEAD STREET — RACINE, WISCONSIN

Frankel

RANGE TAPS



Taps two cables at right angles or in parallel and may be used as a TWO-WAY. Only five sizes of this tap cover a full range of cable combinations from 1,000 MCM to 1,000 MCM down to 1/0 to 6. The size illustrated will take 500,000 to 250,000 on main, 500,000 to 1/0 on the branch.

Frankel Solderless Connectors

Body of electrical bronze; Everdur hardware; Underwriter approved.

This connector, because of its varied uses and broad size range is invaluable in an emergency—and with only five sizes is easy to stock.

Catalog 4-C on request

FRANKEL CONNECTOR CO.

27 VESTRY STREET · NEW YORK 13, N. Y.

NEW LOW PRICE
$12.75 LIST
Telechron MOTORED

A low price switch with evening dimming feature. The new PS-30 is a worthy running mate for the Paragon PS, successfully used by thousands of poultry men. A precision-built, rugged, dependable switch. Authorities have proven that both morning and evening lighting greatly increases egg production per pound of feed.

Season Starts September 1st

Large quantities of the new PS-30 and basic materials for additional quantities are now in Paragon stocks. Recent enlargements in plant . . . modernized manufacturing methods . . . and fortunate position as to availability of raw materials enable Paragon to make quick shipments . . . and to make savings in manufacturing costs reflected in the new low price. However, food shortages indicate huge demands for poultry switches to increase egg production. Help the Farmer lower his cost by getting more eggs per pound of feed. Be prepared to meet this demand. Order your poultry switches early.

Paragon designs and manufactures time controls for every need.

PARAGON ELECTRIC COMPANY
1614 TWELFTH STREET
TWO RIVERS, WISCONSIN

"Mr. TOPS" Paragon Symbol of Top Quality

Paragon Two Rivers WISCONSIN
BUILDERS OF ELECTRICAL EQUIPMENT . . . SINCE 1905

company will manufacture electrical wire and cable of the heat and flame resistant types, for use in lighting fixtures and appliances. The company will gradually expand into other types of insulation, such as glass and synthetic.

•

The Camfield Manufacturing Company of Grand Haven, Mich., which has been operating as a partnership, has been incorporated. All of the partners have become stockholders in the corporation and the control and the continuity of the management remains the same. Officers of the corporation are: R. W. Camfield, president; R. H. Lillyblad, vice president in charge of manufacturing; P. D. Higgins, vice president in charge of purchasing, E. L. Taylor, vice president in charge of sales, and L. V. Meyering, secretary-treasurer.

•

Curtis Lighting, Inc. of Chicago has announced the appointment of Walton T. Woods, Jr. as lighting representative in Atlanta. This territory includes Georgia, South Carolina and parts of Florida and Alabama.

•

Lovejoy Flexible Coupling Co., Chicago, has acquired in entirety, the manufacture and sales of the mechanical power transmission department of Ideal Industries, (formerly Ideal Commutator Dresser Co.,) of Sycamore, Ill.

•

The Acme Electric & Manufacturing Company, Cuba, N. Y., has changed its name to the **Acme Electric Corporation** and is incorporated under the State of New York.

•

Weston Electrical Instrument Corporation is constructing a large new engineering and administration building on the plant grounds at Newark, N. J.

•

The Lincoln Electric Company, Cleveland, Ohio, has augmented its staff of field welding engineers. Gordon Appleby has joined the Philadelphia branch office; Terril S. Hoffman in St. Louis; E. James Langhurst in Chicago and Garrett S. Parsons in Los Angeles.

•

Electric Machinery Mfg. Company, Minneapolis, Minn. has appointed Russell Ranson, 116½ East Fourth Street, Charlotte, N. C. as sales representative for North and South Carolina.

•

Pyrne & Co., Inc. have moved their main plant into larger quarters at Pomona, a suburb of Los Angeles. The sales office will be maintained in Los Angeles.

Where can you find a market so unsaturated. Every home owner who uses a side arm gas water heater (and 2 out of 3 have them) can use and will buy a **Sav-U-time** once you tell him about it. A **Sav-U-time** gives all the advantages of automatic hot water with gas savings up to 50%—touch button control from bathroom, kitchen and laundry turns on the gas water heater providing hot water quickly, economically and just when needed.

Low Cost and 100% Profit for You

Sav-U-time is priced at $39.50 plus a small installation charge—and there's a 100% for you. Low enough price to make sales easy and high enough profit to make it well worth while for you.

Territory Open for Dealers

Here is a wanted product with immediate deliveries being made. Dealers in St. Louis, Detroit and Philadelphia are ordering and reordering. Some territories are still available for dealerships. National advertising, dealer helps support you. Write or wire for details now.

SAV-U-TIME SALES CO.
76 MANHATTAN STREET
ROCHESTER 2, NEW YORK

Sav·U·time

Electricity

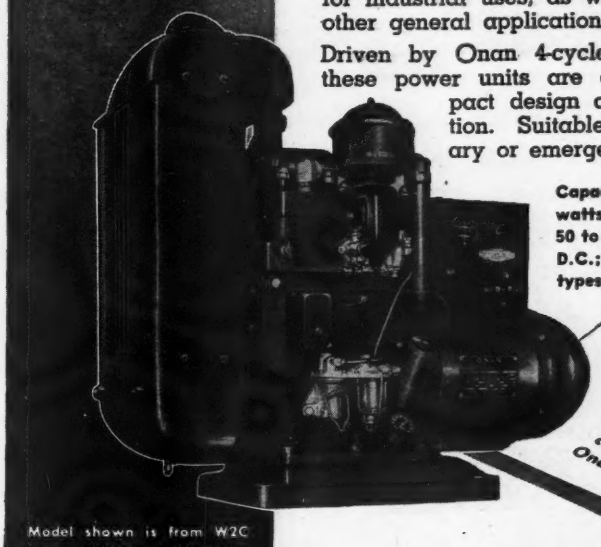
Onan
ELECTRIC PLANTS

FOR ANY JOB—ANYWHERE

ONAN ELECTRIC GENERATING PLANTS supply reliable, economical electric service for industrial uses, as well as for scores of other general applications.

Driven by Onan 4-cycle gasoline engines, these power units are of single-unit, compact design and sturdy construction. Suitable for mobile, stationary or emergency service.

Capacity range: 350 to 35,000 watts; 115 to 660 volts A.C., 50 to 800 cycles; 6 to 500 volts D.C.; combination A.C.—D.C. types.



Write For Folder 690 describing complete Onan Line

Model shown is from W2C series: 2000 to 3500 watts; powered by Onan two-cylinder, water-cooled engine.

D. W. ONAN & SONS
2118 Royalston Ave. Minneapolis 5, Minn.

LUMINITE

REG. U. S. PAT. OFF.

Automatic Switch Light!

FOR BOTH SINGLE AND MULTI-GANG SWITCHES

LISTED BY UNDERWRITERS LABORATORIES, INC.

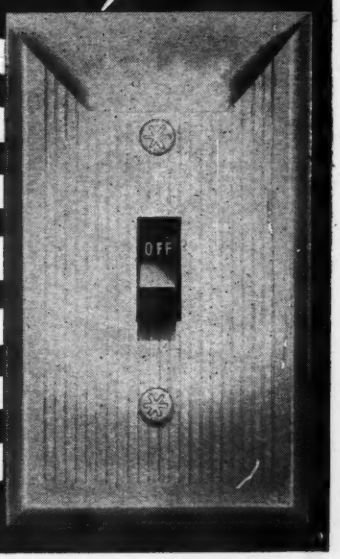
NATIONALLY ADVERTISED IN LEADING MAGAZINES

WIRING TERMINALS FOR EASY INSTALLATION

UNCONDITIONAL RENEWAL GUARANTEE

BEAUTIFULLY STREAMLINED IN GENUINE PLASKON

LITERATURE AND DISPLAY HELPS



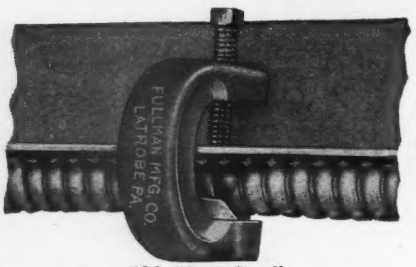
The tiny shielded electric light is *always on* when the room is dark — *always off* when the room lights are on. Ends fumbling for switches. No more smudged walls. Single-gang, two-gang, and multi-gang assemblies available. Operates for less than 2c per year. Works also on 3- and 4-way switches. Guaranteed. For steady profits, sell the *original* LumiNite. List price $1.00. Write for details.

ASSOCIATED PROJECTS CO., 80 E. Long St., Columbus 15, Ohio

FULLMAN Latrobe PRODUCTS

FLOOR BOXES ★ WIRING SPECIALTIES

The ease of installing "Latrobe" products is a factor that can't be brushed aside. It means important time-saving, labor-saving, money-saving—at the time of installation. Then too the superior quality of these products assures long trouble free service.



480 "Bull Dog" Armored Cable Support

Convenient and secure for hanging armored cable to steel work. Serves equally well for temporary and permanent jobs.

No. 284 Nozzle

Duplex Receptacle Nozzle with ½" brass pipe extension. Very Compact. Also furnished with ¾" pipe extension.

No. 150 Box; No. 207 Nozzle

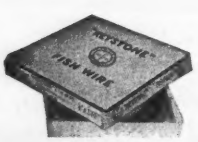
Underwriters' approved. For installation in concrete or in wood finished concrete floors.

"Bull Dog" Insulator Supports

Malleable iron of high tensile strength —Convenient for fastening porcelain or glass insulators to exposed steel framework. Four sizes to accommodate all standard porcelain or glass insulators.

"Bull Dog" BX Cable Staples

We can furnish these high quality staples in any quantity. Packed in cartons, kegs or barrels.



Keystone Fish Wire

Finest grade flat steel wire. Ten sizes. Coils from 100 ft. up.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

WIRING FOR QUICK CHANGE

[FROM PAGE 54]

pending upon the intensity desired.

To add to the flexibility of the lighting distribution, all fixtures mounted in suspended ceilings are connected by six-foot cord and plug to receptacle outlets spotted on approximately 10-ft. centers above the roof truss chords (Fig. 8). Each outlet contains two duplex 3-wire receptacles, providing a connection for four units. This scheme eliminates circuit connection problems when fixtures are relocated or new units added to the system.

Catwalk Servicing

Access to the lighting receptacle outlets and the fixtures is provided by 18- and 24-inch wide catwalks built into the roof truss structure and so located that units can be serviced from either side. Clearances above the suspended ceilings vary somewhat, that above the shop area being 10 feet. Although this space is badly cut up by the truss structure, the catwalks are reasonably clear providing ample space for working on the units.

To facilitate quick servicing of fixtures —particularly cleaning (every six months) and lamp and starter renewals —the units are a special two-section design. The lower section is the reflector (sides and ends) which is mounted to the supporting iron of the suspended ceiling, the bottom rim being flush with the acoustic tile. The upper section, comprising the fixture body with ballast, starters, lamps, etc., has protruding side flanges which slide over the stationary reflector and are rigidly fastened with thumb-screw mounting bolts. Handles for lifting are provided on the fixture body.

To service a unit, the maintenance man merely disconnects the connecting cord, loosens the thumb-screws and lifts the unit from the reflector (Fig. 2). He then places it on the catwalk (Fig. 9) and makes whatever replacements are necessary. If the unit needs major repairs, it is immediately replaced with another fixture and taken to the shop. Above-ceiling maintenance does not disrupt production as would floor maintenance with all the necessary ladders, equipment and the inherent distraction of machine operators. Lighting maintenance can be carried on without workers on the main floor being aware of it.

The combined flexibility of the removable acoustic ceiling panels and the catwalk access to the lighting circuits

It does the job...

● The latest Aerovox catalog lists both exact-duplicate and universal types of motor-starting capacitor replacements. Select the type you prefer. Get it from your Aerovox supplier. Install it. Forget it.

You'll make a handsome profit—and keep it—because there are no comebacks when you install Aerovox capacitors. Therefore, ask your Aerovox supplier for our latest catalog—or write us.

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

AEROVOX CORP., NEW BEDFORD, MASS., U.S.A.
Export: 13 E. 40th St., New York 16, N.Y. • Cable: 'ARLAB'
In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

The Blows that SAVE

You MONEY and TIME

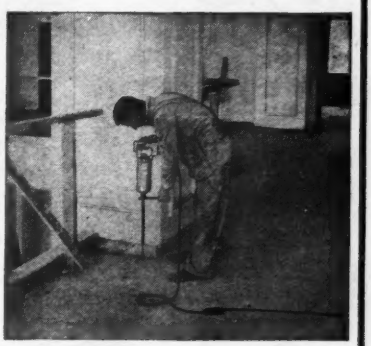
3600 Powerful, Hard-hitting Blows per Minute with

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

Drilling — Cutting — Chipping in concrete and masonry



These sturdy, dependable tools operate from ordinary 110 volt A.C. light source (220 volt to order), and will drill 10 holes in concrete to 1 by hand.

Write for new Catalog No. 464

SYNTRON CO.

690 Lexington Homer City, Pa.

Commutators

OVER 3000 OF 15 BASIC TYPES

Many of these Commutators are in our stock ready for shipment. Other types and sizes may be made from our tools promptly. *Write or Wire*

THE TOLEDO STANDARD COMMUTATOR CO.
2242 SMEAD AVE. TOLEDO 6, OHIO

3 FACTORIES
to serve you
TOLEDO · HOMER · HILLSDALE

Monarch Fuse
SPRING CLIPS

FERRULE TYPE

KNIFE BLADE TYPE

Prevent Fuse Failures Due to Terminal Heating

Tighten Fuse Contacts

Monarch DOUBLE END WRENCH

Users of Monarch Renewable Fuses are provided with this ingenious wrench . . . designed to fit nuts on any and all sizes of our fuses.

MONARCH FUSES Are Available Through RECOGNIZED WHOLESALERS

Specify Monarch Fuses *for improved*

FUSErvice

MONARCH FUSE CO., LTD.
118 E. FIRST ST., JAMESTOWN, N. Y.

simplifies fixture relocation. Frequently during the war years, the general lighting pattern was rearranged to increase or decrease intensity in a specific area to conform to a revised machine grouping.

Among the numerous safety features at the Woodward plant are several of an electrical nature. Photo-electric cells installed in the air conditioning system shut off the fan motors and close all dampers in case of smoke detection; strategically located switches, connected to the main switchboard breakers through shunts, can also shut down the air conditioning system in case of emergency; fire relays (thermostats connected through relays) are connected in series to cut out all fans and close all connecting dampers in the air duct system in case temperature in any of the ducts reaches a danger point. Fire doors with fused links are installed in all openings in the plant. The fan rooms and electrostatic air filters are equipped with sprinklers; the test room with a CO_2 extinguishing system.

The plant has a complete public address system. This can be used for standard radio broadcasts, for record transcriptions, as a paging system, and to give instructions throughout the entire area during an emergency. A plant intercommunicating telephone (PAX) system is also in operation. By dialing the proper number any telephone can be connected to the paging system for emergency calls.

Considerable thought, planning, energy and money were spent in the construction of this plant. New design and operating ideas were introduced. Was it worth all the effort?

Woodward completed their plant just prior to the entry of the United States in World War II. Defense production became war production and we all know what that meant—continuous 24-hour operation seven days per week; frequent regrouping of production equipment to handle specific contracts; pushing electrical systems to the breaking point; maintaining production efficiency.

Four years of operation under wartime pressure have proved the wisdom of the design. Throughout this period it was necessary to make many changes in the various plant facilities—water, air, electrical, telephone, oil and refrigeration—in order to proceed with war production. All of them were installed in the suspended ceiling area. This, plus the unusual flexibility of the lighting and power systems have saved the company many thousands of dollars according to estimates. Add to this the saving in routine maintenance and you have some conception of what this design has meant to the Woodward management.

PARTS FOR FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCK

AUTHORIZED PARTS DISTRIBUTOR

Brown-Brockmeyer	General Electric	Master
Century	Hamilton-Beach	Peerless
Cutler-Hammer	Holtzer-Cabot	Robbins & Myers
Delco	Howell	Star
Diehl	Hunter	Thor
Duro	Ilg	Wagner
Emerson	Leland	Westinghouse
	Marathon	

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

200 William St. *Barclay 7-6616* **New York 8, N. Y.**

Get This Complete Data on Selling Guth Germ-Killing LIGHTS

NO PRIORITY NEEDED! QUICK SHIPMENTS!

GUTH Germ-Killing Lights provide you with one of the best profit-building opportunities in the whole industry! Every school, office, restaurant, and public building—as well as dairy, horse and poultry farms, food processors, meat markets, etc., are *all* potential buyers.

We have pioneered in designing and building *Germ-Killing Lights*, and our experienced engineering service is bound to help make selling easier for you.

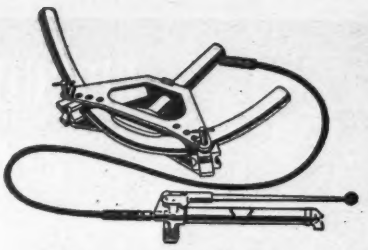
Write today for detailed Bulletins on GUTH Germ-Killing Lights. They are packed with real, usable information to help you sell.

GUTH GERM-KILLING LIGHTS

Work More Effectively than a Surgeon's Mask

Guth

The Edwin F. Guth Co. • 2615 Washington Ave. • St. Louis 3, Mo.



When you buy a

BENDER

.. check to make sure you get these features:

EASY TO GET TO THE JOB

☑ Lightweight, portable—one man can easily take a Blackhawk Pipe Bender right to the job. Bends rigid conduit and pipe in all popular sizes, up to 4" dia.

WORKS AT ALL ANGLES

☑ The compact hydraulic Porto-Power Ram is all-directional. Power eliminates need for heating the pipe.

WORK OVERHEAD

☑ All-directional operation and light weight enlarges range of utility to use on ladders, scaffolds and cramped quarters and work on existing pipe runs.

SIGHT FROM ANY ANGLE

☑ Remote control permits operator to stand in any position for a full view of the job. Saves need for elbows, couplings, cutting and extra threading.

DETACHABLE POWER UNIT FOR EXTRA UTILITY

☑ It pulls gears, lifts machinery, and licks scores of other trouble jobs.

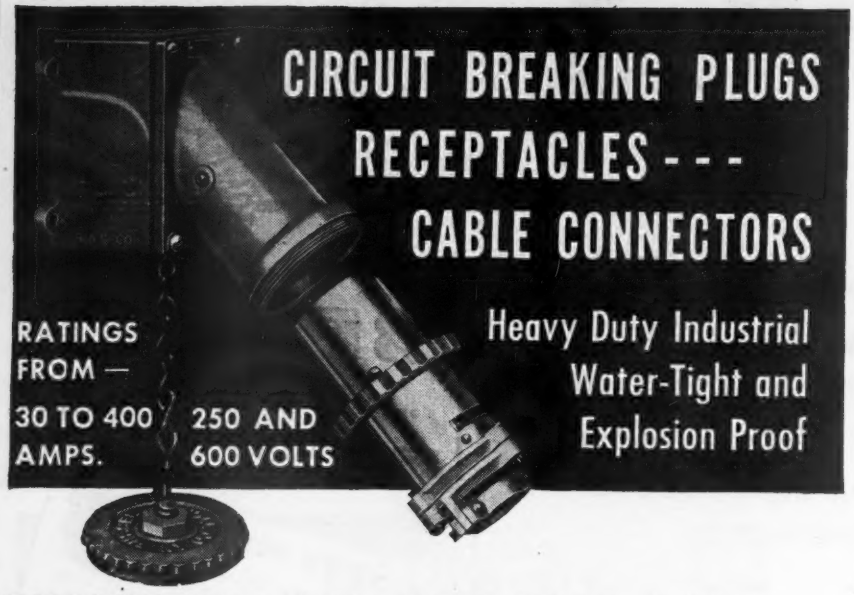
BLACKHAWK Porto-Power PIPE BENDERS

BLACKHAWK MFG. CO.
Dept. P 2086 Milwaukee 1, Wis.
Mail Hydraulic Equipment catalog to:

NAME_____

COMPANY_____

ADDRESS_____



CIRCUIT BREAKING PLUGS
RECEPTACLES - - -
CABLE CONNECTORS

RATINGS FROM — 30 TO 400 AMPS. 250 AND 600 VOLTS

Heavy Duty Industrial Water-Tight and Explosion Proof

ENGINEERED AND PRECISION BUILT—

FOR SAFE OPERATION

Positive grounding by means of housing and separate contact for safety circuit wire.

Polarized by means of contact arrangement and groove and key in housing. Impossible to insert plug incorrectly.

All contact surfaces are precision machined and adjusted for maximum contact pressure, reducing arcing to a minimum.

Arcing chamber is completely inclosed. Arc is extinguished before plug is completely removed.

FOR LOW MAINTENANCE

Contacts—free floating, self-wiping, stay clean and retain full contact pressure.

Sealed cable grip — no strain on connections. Excludes all dust and moisture.

Ground surfaces and durable oil-resistant gaskets.

Liberal space for wiring, quick and easy access. Facilitates inspection and servicing.

FOR EASE OF INSTALLATION

Substantial external lugs for easy mounting.

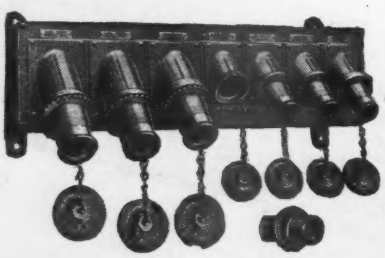
Boxes will accommodate a variety of conduit outlets to suit all job requirements.

Ample wiring space and substantial terminals make wiring easy.

Assembly of interior and contacts requires no special tools.

Interiors do not extend back of covers permits direct assembly to cabinets without internal interference.

A high degree of standardization and interchangeability of parts provides a wide variety of types and sizes to suit every requirement.



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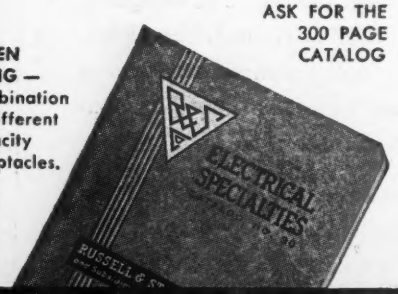

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BRIDGE HANDRAIL LIGHTING

[FROM PAGE 57]

globe cleaning. The comparative distance between lamp housings and pavement is another factor reducing illumination intensity on the roadway. The power consumption used to light the pictured viaduct is 5400 watts.

A night view of the new bridge handrail lighting strikingly illustrates the improvements initially mentioned (Fig. 2). Identical film, time and aperture were used in taking the two views. A greater number of lamps, spaced at reduced intervals, permits the use of lower wattage lamps, reducing point brightness and resultant glare. The reflection of light rays downward and towards the center of the roadway prevents the dissipation of useful illumination. Safety is promoted with the elimination of attention-diverting details in the neighboring areas. Conduit runs are shortened, construction of poles is unnecessary and ladderless maintenance becomes possible. The power consumption on this bridge span is 3600 watts. The length of the bridge is equal to that of the viaduct. The total power consumption used to light the bridge is two-thirds that consumed in furnishing the less adequate illumination for the viaduct. Dual circuits along the bridge handrail permit halving the load to 1800 watts with lamps spaced at 40-foot intervals instead of 20 feet as shown. Under this arrangement lamps are staggered alternately on opposite rails. Tests have demonstrated that, even with this 66 percent power reduction, the efficient handrail lighting design provides illumination superior to the conventional pole mounting installation.

Details of the bridge handrail lighting fixture indicate recommended conduit connections and the proper recessing of the Tuflex glass-faced housing. The diagrams also present the prescribed positioning of lamp and details of the bolted receptacle holder. Experience resulting from this installation has demonstrated that the new design provides adequate illumination and this intensity can safely be reduced in the future. The double reflector cusp behind the lamp, shown in the plan diagram of the housing, is a definite improvement over the original design which carried the reflectors in plane surfaces further back to a sharp intersection. Smaller housings and lower watt lamps are feasible, promising still greater savings in construction costs and power consumption.

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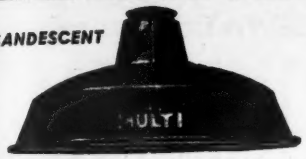

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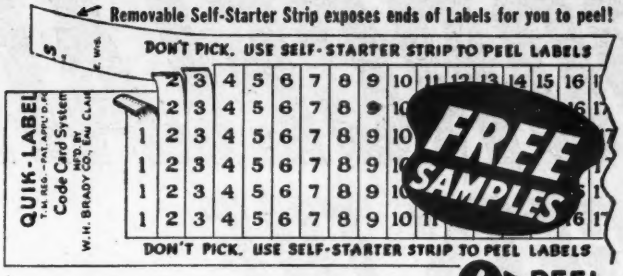
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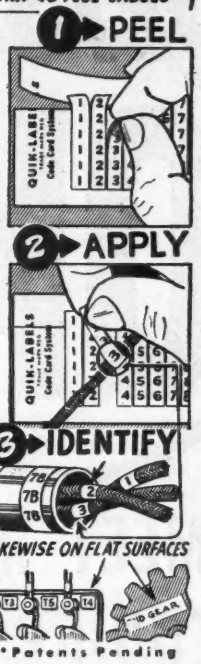

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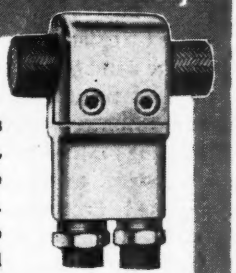

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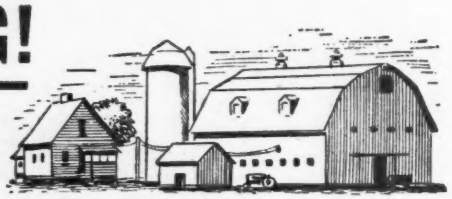

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SUPPORTS FORM RACEWAY

[FROM PAGE 63]

existing outlets in the drafting room ceiling by a thin-wall conduit drop. Feed-in box connection to the strut is shown in Fig. 4 with snap-on covers in place.

Circuit conductors were laid in the Unistrut channel. Receptacles for each fixture were spotted, connected and clamped to the strut. Slot covers, cut to the proper length, were then snapped on. Both rod and fixture hanger clamps were so designed that the Unistrut cover slips under them before they are tightened. The same applies to the U-bolt connections to the roof trusses.

If additional outlets are required, the electrician removes the strut cover, installs the receptacle, cuts the cover to fit and replaces it (Fig. 5). The conductors in the channel have sufficient slack to permit this.

Structural design of the building divides the drafting room into numerous 20-ft. by 25-ft. bays. The new lighting system provides eight 200-watt fluorescent units (Sylvania type C-200 SA), each equipped with four 40-watt, 3500-degree white tubes, in each bay. Fixtures—on 10-ft. by 6-ft., 4-in. centers —are chain suspended from the Unistrut 10-ft. above the floor and connected to the circuits by flexible cords. Thus, to maintain a unit, the electrician merely pulls out the cord plug, unhooks the fixture and replaces it with a new one while the damaged one is being repaired. Groups of fixtures are controlled from column-mounted switches.

Lighting intensity provided by this new system averages 55 footcandles maintained (reading taken at night). Previous lighting with four 300-watt incandescent units per bay provided a maximum of 20 foot candles—necessitating the use of supplemental lighting on each drafting table.

System Advantages

The 20-ft. span and a structural strength of Unistrut permitted the suspension of the heavy fluorescent fixtures with a minimum number of supporting rods (one per 20-ft. bay); the use of the strut channel as a raceway eliminated the need for parallel lines of circuit conduits to serve the fixtures; the installation ease and the accessibility of the wiring in the channel for quick additions of outlets added considerably to the flexibility of the lighting system. These were the significent features that led to "Caterpillar's" decision to utilize this system of distribution wherever practicable for fluorescent lighting installations.

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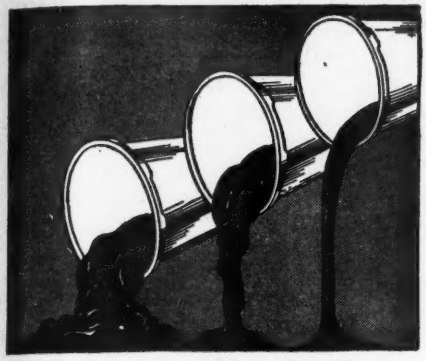

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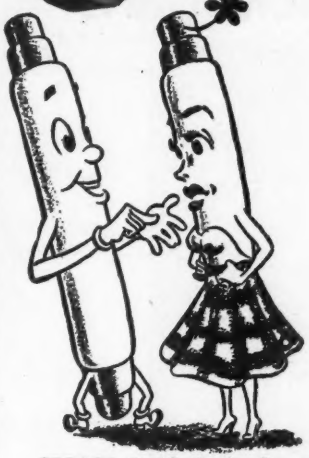

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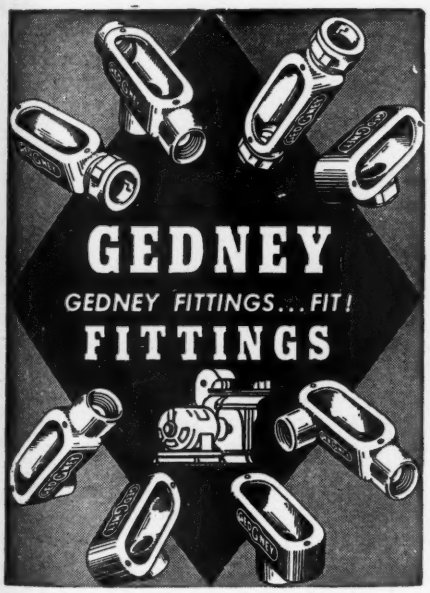

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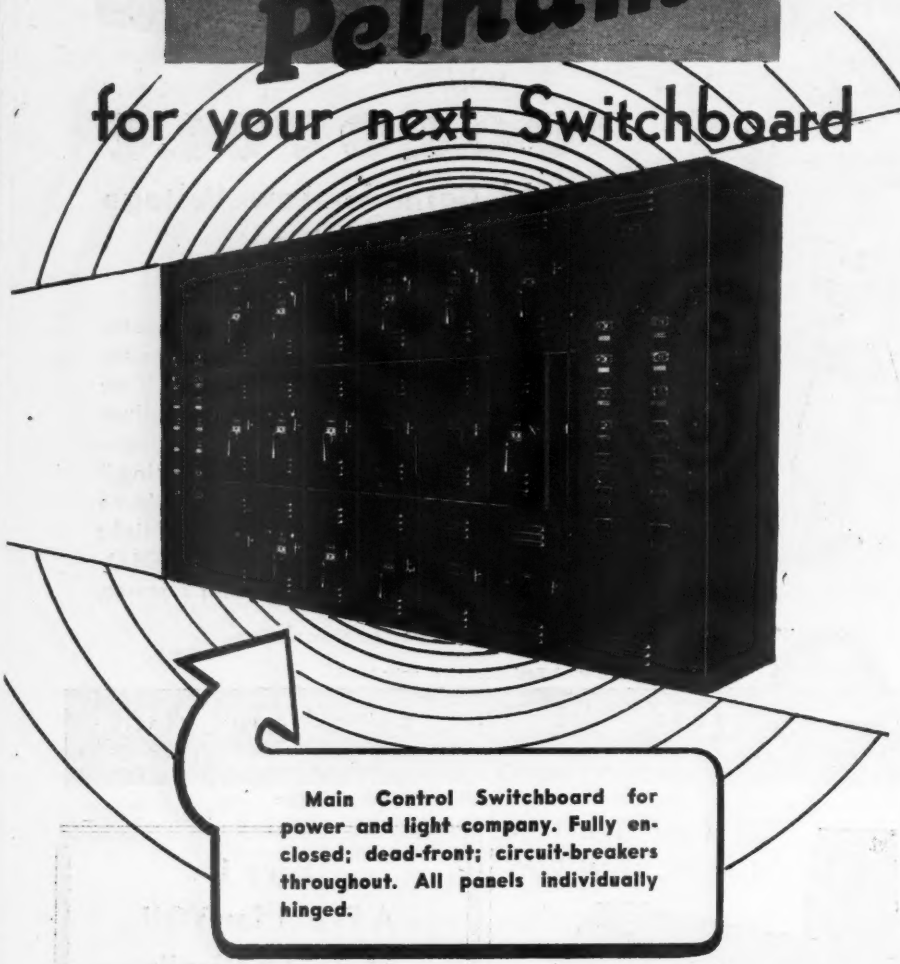

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[FROM PAGE 45]

take 6 pole-phase groups of 5 coils each (30 coils) and 6 pole-phase groups of 4 coils each (24 coils), totaling 54 coils, placed alternately around the stator for preserving winding symmetry. This arrangement is shown in Fig. 7b. When the number of coils per pole-phase group is a whole number, the expedient of unequal grouping does not become necessary.

The number of turns in series per phase on the 25 cycle delta-connected winding will be:

$$T_2 = T_1 \times f_1/f_2 \times p_2/p_1 \times K_1/K_2$$
$$= 450 \times 60/25 \times 4/6 \times 0.940/0.961$$
$$= 704 \text{ turns or } 704 \text{ turns}/18 \text{ coils} = 39 \text{ turns per coil.}$$

If a star-connected winding is to be used, the number of turns per phase will be 704 turns / 1.73 = 406 or 23 turns per coil.

Summarizing the foregoing and taking into consideration changes in frequency f, number of poles p, voltage E, chord factor K, distribution factor D, and number of phases which appears in the voltage as voltage per phase or single-phase voltage, the general equation for figuring any new winding becomes:

$$T_2 = T_1 \times f_1/f_2 \times p_2/p_1 \times E_2/E_1 \times K_1/K_2 \times D_1/D_2$$

where subscripts 1 and 2 denote constants before and after the change.

Example.—A three-phase, 220 volt, 25 cycle, 4-pole or 725 rpm., series-star connected motor with 40 turns per coil is to be rewound to operate at about 1150 rpm. on a single-phase, 120 volt, 60 cycle supply. Calculate the new number of turns.

The voltage per phase of the 220 volt series-star connected stator winding is 220 volt / 1.73 = 127. The total number of turns per phase is 16 coils x 40 turns per coil = 640. The chord factor of the three-phase winding is calculated as described previously and found to be 0.866. The three-phase distribution factor is taken as 0.955, as usual. A suitable single-phase winding layout is assumed and its distribution factor calculated as before. In this case, it is found to be 0.790. For simplicity, the halves of the three-phase and single-phase windings with their terminal connections are shown in Figs. 8a and 8b, respectively. The starting winding, not shown in the drawing, may be designed along the lines described under three-phase to single-phase winding conversion and placed 90 electrical degrees apart from the main winding. Therefore, T = 22 turns per coil.

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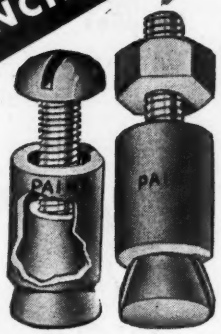

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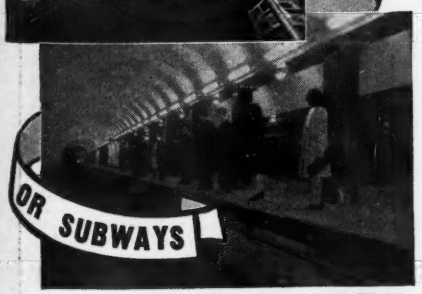

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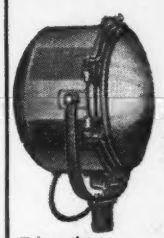

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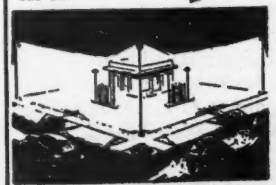

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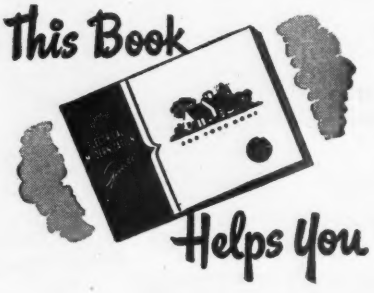

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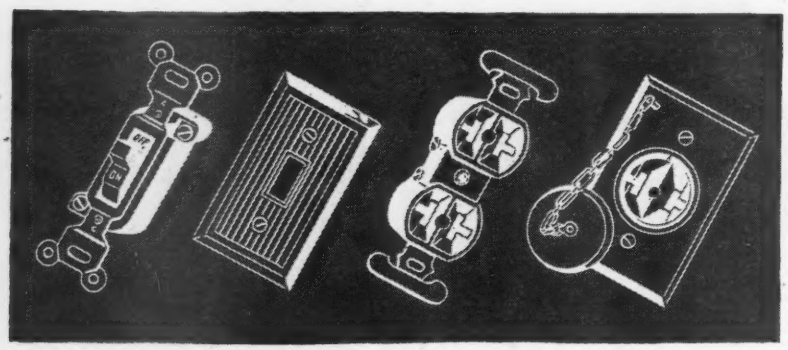

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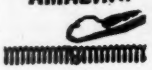

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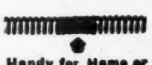

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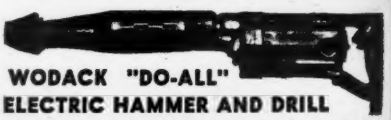

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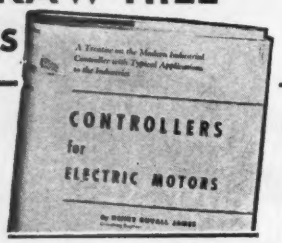

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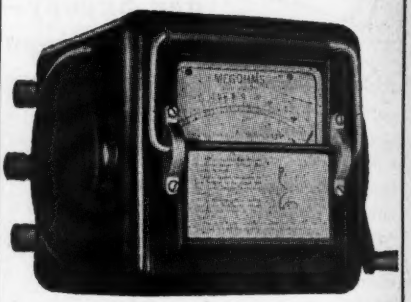

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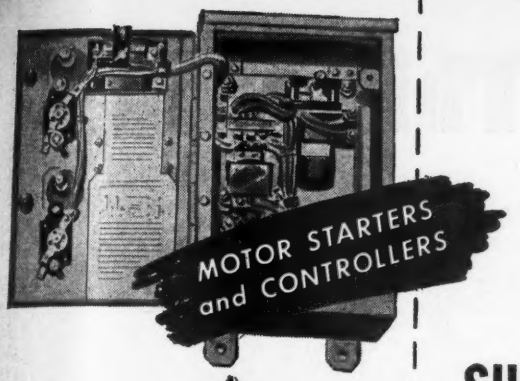

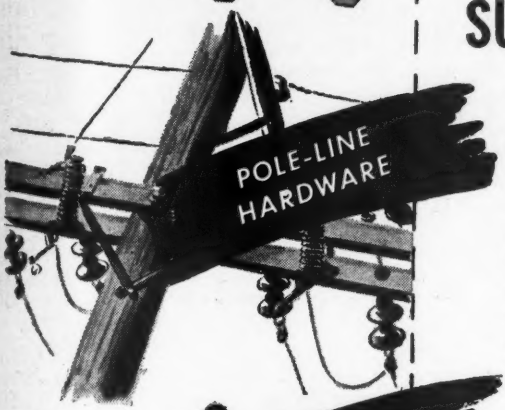

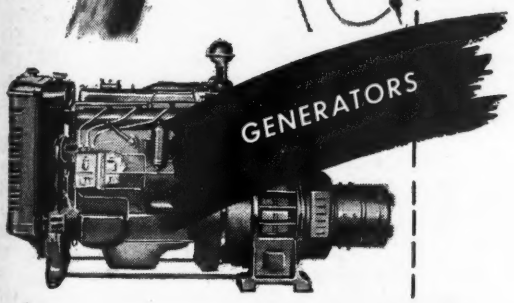

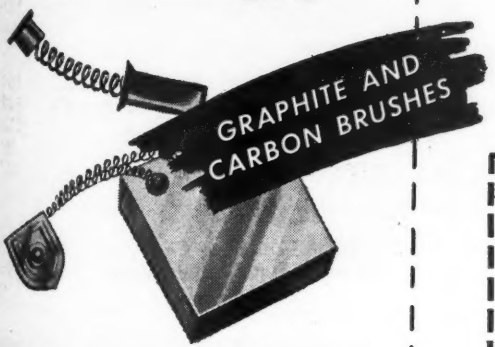

AVAILABLE NOW!

AT REDUCED PRICES

SURPLUS ELECTRICAL EQUIPMENT

Electrical equipment and material in large quantities are now available in many locations throughout the country. Complete information may be obtained from the nearest Regional Office of the War Assets Administration.

Included in this war surplus inventory are hundreds of items of standard and special equipment—pole-line hardware, wire and cable, motors, switch gear, wiring devices, power-conversion and sub-station equipment. The special items in many cases can be adapted or converted to your needs. *Priced to sell*, these items will help solve the electrical supply problems of manufacturers, industrial contractors, wholesalers and dealers—investigate today.

1 **MOTOR STARTERS AND CONTROLLERS** — General Electric, Westinghouse, Cutler-Hammer, Ward Leonard and other makes, built to both commercial and Navy specifications. 115 and 230 volt d-c; 220 and 440 volt a-c., 60-cycle, 3 phase, drip proof, waterproof, manual and magnetic types. Unused and used. Substantial savings.

2 **Pole-Line HARDWARE**—Insulators, pins and nearly all other items of pole line hardware for transmission, distribution and communications lines. Well-known makes, meeting exacting Government specifications, new, in excellent condition.

3 **GENERATORS**—Engine driven, 100 kw., single bearing, 120/240 volt d-c., 1200 rpm. commercial and industrial types. Unused and in good condition. Many other sizes—gasoline, diesel, steam and electrically driven, and generators without prime movers, a-c and d-c. Check our large lists.

4 **Graphite and Carbon BRUSHES**—Large quantities of new brushes of well-known makes, in a wide range of sizes, in both standard and special types for motors, generators and other rotating electrical machinery.

Although this material has been previously offered to priority claimants 10% of the merchandise has been reserved to fill any further needs of priority claimants, including Veterans of World War II, who are invited to contact the Regional Office serving their Area with respect to this material.

(CUT OUT AND SEND TO THE NEAREST WAA OFFICE LISTED BELOW)

War Assets Administration: I am interested in the following checked items:

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GENERATORS	POWER-CONVERSION EQUIPMENT
SWITCH GEAR	SUB-STATION EQUIPMENT
SPECIAL ELECTRIC MOTORS	PROTECTIVE EQUIPMENT

Name..... Tel. No.....

Firm.....

Address.....

City..... State.....

319-3

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t 1946

If I was Selling Farmers on the Idea of MULTI-BREAKERS *Here's what I'd Tell Them...*

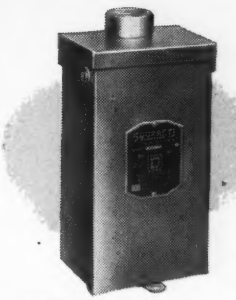
FIRST OFF, I'd remind them that electricity is one of the most important workers on the farm. In the house, the barn, the milk house, the chicken house, the tool shed—electricity is on the job 24 hours a day.

Then I'd remind them of the importance of *uninterrupted* electrical service. There shouldn't be any "time outs" when electric incubators and brooders are at work. Or water pumps, milking machines, heaters and the like. And yet, if they've ever tried to replace a blown-out fuse with a new one they haven't got, they know there can be plenty of such "time outs." It's a long way to town.

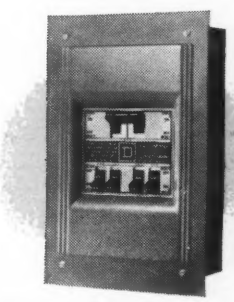
Now, with the Multi-breaker they don't worry about such things. You see, the Multi-breaker gets rid of fuses —completely.

In case of an overload or a short circuit, the current is shut off automatically. And a simple flip of a lever restores the current after the cause of the trouble has been removed. No fuss, bother or delays.

If I was an electrical contractor, that's how I'd sell the Multi-breaker idea to farmers. Know why? That's how my contractor sold me!



MULTI-BREAKERS are available in a wide range of capacities and for every application. Illustrated above, in rain-proof enclosure for outdoor installation.



MULTI-BREAKERS cost little more than the fusible equipment they replace—often less. And the first cost is the last. There's nothing to replace.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

IT'S PVX THE NEW NON-METALLIC SHEATHED CABLE FOR RESIDENTIAL AND FARM WIRING

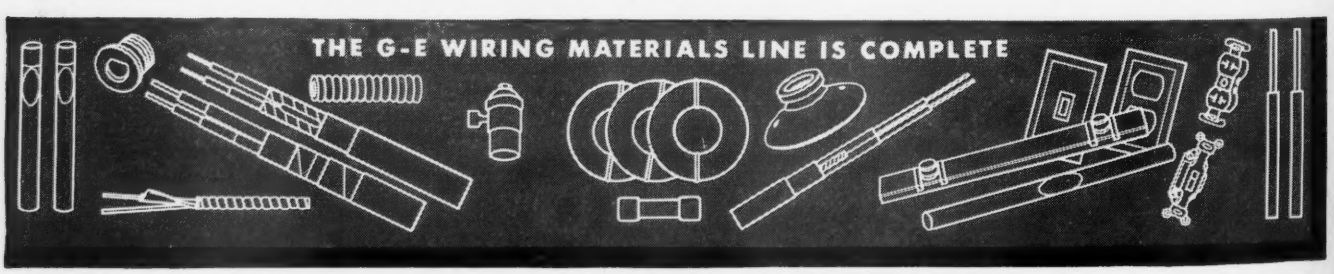
REGISTERED TRADE MARK

Take a good look at the benefits of this new thermoplastic-insulated cable. Check its features against your jobs' requirements. You'll find many reasons for using it in new wiring, rewiring or maintenance work.

The Type T thermoplastic-insulated conductors, paper wrap, and over-all braid on PVX all strip easily to save time in making splices and connections. PVX (14-2) weighs only 77 pounds per 1000 feet, or 27 pounds lighter than comparable Type R non-metallic cable. This lighter weight makes handling and installation easier, reducing "wear and tear" on busy workmen. The over-all braid is tough and moisture resistant, with an improved finish that makes it smooth and non-tacking.

There are many other advantages that make PVX especially well suited for open and concealed work where permitted by local Codes and the National Electrical Code. It resists flame, oils, acids, and alkalies. Conductors are permanently colored for positive identification. PVX is available with two or three conductors in sizes 14 to 4, approved for 60 C operation.

Ask your G-E Merchandise Distributor for more complete information, or write to Section W2-8-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.



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